



Docket No.NEC03P013-TTd

WAK.131

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Morihisa Momona

Serial No.: 10/512,144

Group Art Unit: 2416

Filed: October 22, 2004

Examiner: Pham, Brenda H.

For: MOBILE COMMUNICATION NETWORK SYSTEM AND MOBILE
COMMUNICATION METHOD

Honorable Commissioner of Patents
Alexandria, Virginia 22313-1450

**SUBMISSION OF VERIFIED ENGLISH TRANSLATION
OF THE PRIORITY DOCUMENT**

Sir:

Submitted herewith is a copy of the verified English translation of the Specification, Claims, Abstract, and Drawings dated March 3, 2009, that the English translation is a true English translation of the Japanese Application Number 2002-123502 filed April 25, 2002, upon which application the claim for priority is based.

Approval and acknowledgment of receipt are respectfully requested.

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Japanese Application of

Morihsa MOMONA

Japanese Patent Application No.: 2002-123502

Japanese Patent Filing Date: April 25, 2002

for: "MOBILE COMMUNICATION NETWORK SYSTEM AND MOBILE
COMMUNICATION METHOD"**VERIFICATION OF TRANSLATION**

Honorable Commissioner of Patents and Trademarks

Washington, D.C. 20231

Sir:

Toshio TAKAMORI residing at c/o WAKABAYASHI PATENT AGENCY, 16th Kowa
Bldg., No.9-20, Akasaka 1-chome, Minato-ku, Tokyo 107-0052 Japan, declares:

- (1) that he knows well both the Japanese and English languages;
- (2) that he translated the above-identified Japanese Application from
Japanese to English;
- (3) that the attached English translation is a true and correct translation of
the above-identified Japanese Application to the best of his knowledge and belief;
and
- (4) that all statements made of his own knowledge are true and that all
statements made on information and belief and believed to be true, and further that
these statements are made with the knowledge that willful false statements and the
like are punishable by fine or imprisonment, or both, under 18 USC 1001, and that
such false statements may jeopardize the validity of the application or any patent
issuing thereof.

March 3, 2009

Date

Toshio Takamori

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• [Document Name] Patent Application
[Docket Number] 21200239
[To] Commissioner, Patent Office
[International Classification] G01N 21/64
G01N 27/447
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[Indication of Official Fees]
[Advance Deposit Record Number] 021566
[Amount paid] 21000
[List of Materials Submitted]
[Material Name] Specification 1
[Material Name] Drawings 1
[Material Name] Abstract 1
[Number of General Power of Attorney] 0004343
[Proof] Requested

[Document Name] Specification

[Title of the Invention] Mobile Communication Network System And Mobile Communication Method

[Claims]

[Claim 1]

A mobile communication network system that comprises a mobile communication network, a plurality of external networks, a plurality of mobile terminals, a plurality of gateways, and a plurality of access points, wherein said external networks and said mobile communication network are connected by said gateways, and said mobile terminals are connected to said mobile communication network by said access points, said system characterized in that when packets are transmitted and received between said mobile terminals in said mobile communication network, the packets are communicated by way of virtual networks that are provided to correspond to each of said external networks on said mobile communication network, without passing said external networks.

[Claim 2]

A mobile communication network system that comprises a mobile communication network, a plurality of external networks, a plurality of mobile terminals, a plurality of gateways, and a plurality of access points, wherein said external networks and said mobile communication network are connected by said gateways, and said mobile terminals are connected to said mobile communication network by said access points, said system characterized in that said mobile communication network is provided with means for offering virtual networks that correspond to each said external network, said gateways are provided with means for connecting said external

networks to corresponding said virtual networks,

said mobile terminals are provided with means for setting sessions with said access points for any of said external networks,

said access points are provided with means for transferring packets that have been received from any of said sessions to a virtual network that has been prepared for an external network that corresponds to that session,

said access points are provided with means for transferring packets, which have been received from said virtual network that corresponds to any external network, to a session that has been set for said external network by said mobile terminal that is the destination of these packets, and

private leased line connections are provided between said mobile terminals and said external networks, and when transmission or reception of packets is realized between said mobile terminals in said mobile communication network, the packets are communicated by way of virtual networks that are provided to correspond to each of said external networks on said mobile communication network.

[Claim 3]

A mobile communication network system as claimed in claim 2, characterized in that

when said mobile terminal is to be handed over from a current access point to which it is currently connected to a new access point, said current access point is provided with means for transferring information of all sessions that said mobile terminal has set to said new access point, and

said private leased line connection between said mobile terminal and said external network can be continued without interruption when said mobile terminal implements handover.

[Claim 4]

A mobile communication network system as claimed in claim 2, characterized in that

when said mobile terminal is to be handed over from a current access point to which it is currently connected to a new access point, said new access point is provided with means for acquiring information of all sessions that said mobile terminal has set from said current access point, and

said private leased line connection between said mobile terminal and said external network can be continued without interruption when said mobile terminal implements handover.

[Claim 5]

A mobile communication network system as claimed in any one of claims 2 to 4, characterized in that

a mobility management node is arranged within said mobile communication network,

said mobility management node comprises a plurality of virtual mobility management nodes that are prepared for each of said external networks,

each of said virtual mobility management nodes is provided with means for transmitting and receiving packets only with a said virtual network that has been prepared for use by a corresponding external network,

said mobile terminals is provided with means for reporting positional information to said virtual mobility management node that corresponds to said external network to which the mobile terminal is to be connected,

each of said virtual mobility management nodes is further provided with means for holding positional information that has been reported from said mobile terminals and means for, when packets that are addressed to said mobile

terminals are received, transferring these packets to positions that have been reported from said mobile terminals, and

said virtual networks, that are prepared to correspond to each of said external networks on said mobile communication network, manages the position of said mobile terminals.

[Claim 6]

A mobile communication network system as claimed in any one of claims 2 to 5, characterized in that

said mobile communication network comprises a control/management virtual network,

said mobile communication network further comprises a means for transmitting and receiving, by way of said control/management virtual network, packets for control and management that are exchanged between nodes that are arranged within said mobile communication network and that include said access points and said mobility management nodes; and means for refusing packets for control and management that have been received from sources other than said control/management virtual network, and

the security of the communication among nodes arranged within said mobile communication network is ensured.

[Claim 7]

A mobile communication method in a mobile communication network comprises a mobile communication network, a plurality of external networks, a plurality of mobile terminals, a plurality of gateways, and a plurality of access points, wherein said external networks and said mobile communication network are connected by said gateways, and said mobile terminals are connected to said mobile communication network by said access points, said method

characterized in that

a said mobile terminal sets a session for any of said external networks with said access point,

a said access point transfers packets that have been received from any said session to a virtual network that has been prepared for each of said external networks that corresponds to the session,

said access point transfers packets that have been received from said virtual network that corresponds to any external network to the session that has been set for use of said external network by said mobile terminal that is the destination of the packets, and

private leased line connections are provided between said mobile terminals and said external networks, and when transmission or reception of packets is realized between said mobile terminals, the packets are communicated by way of virtual networks that are provided to correspond to each of said external networks on said mobile communication network.

[Claim 8]

A mobile communication method as claimed in claim 7, characterized in that

when said mobile terminal is to be handed over from a current access point to which it is currently connected to a new access point, said current access point transfers information of all sessions that said mobile terminal has set to said new access point.

[Claim 9]

A mobile communication method as claimed in claim 7, characterized in that

when said mobile terminal is to be handed over from a current access

point to which it is currently connected to a new access point, said new access point acquires information of all sessions that said mobile terminal has set from said current access point.

[Claim 10]

A mobile communication method as claimed in any one of claims 7 to 9, characterized in that

a mobility management node that is arranged within said mobile communication network comprises a plurality of virtual mobility management nodes that are prepared for each of said external networks,

each of said virtual mobility management nodes transmits and receives packets only with a said virtual network that has been prepared for use by a corresponding external network,

said mobile terminals report positional information to said virtual mobility management node that corresponds to said external network to which the mobile terminal is to be connected,

each of said virtual mobility management nodes holds positional information that has been reported from said mobile terminals and, when packets that are addressed to said mobile terminals are received, transfers these packets to positions that have been reported from said mobile terminals, and

said virtual networks, that are prepared to correspond to each of said external networks on said mobile communication network, manages the position of said mobile terminals.

[Claim 11]

A mobile communication method as claimed in any one of claims 7 to 10, characterized in that

said mobile communication network comprises a control/management

virtual network,

said mobile communication network transmits and receives, by way of said control/management virtual network, packets for control and management that are exchanged between nodes that are arranged within said mobile communication network and that include said access points and said mobility management nodes; and refuse packets for control and management that have been received from sources other than said control/management virtual network, and

the security of the communication among nodes arranged within said mobile communication network is ensured.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to a mobile communication network system and to a mobile communication method, and more particularly to mobile communication network system and a mobile communication method in which a mobile communication network provides a private leased line connection capability between external networks and mobile terminals.

[0002]

[Description of the Related Art]

Prior art in which a mobile communication network provides a private leased line connection capability between external networks and mobile terminals includes GPRS (General Packet Radio Service), which is a mobile communication technology prescribed by the ETSI (European Telecommunications Standards Institute) and 3GPP (Third-Generation Partnership Project). GPRS both supports movement of terminals and provides

private leased line connection capabilities for connecting mobile terminals to specific external networks.

[0003]

In addition, a mobile control technology that has been developed by IETF (Internet Engineering Task Force) includes Mobile IP (RFC2002) and a private network technology that includes IPSEC. A combination of these technologies supports the movement of terminals and can realize private leased line connections between mobile terminals and external networks.

[0004]

Still further, technology proposals exist for using a virtual private network technology in a core network of a mobile communication network for connecting mobile terminals to external networks, one example being disclosed in <http://www.microsoft.com/technet/treeview/default.asp?url=/TechNet/itsolutions/network/deploy/depovg/ieee802.asp>.

[0005]

[Problem to Be Solved by the Invention]

However, the above-described technology has various problems as described hereinbelow.

[0006]

In the above-described GPRS, tunnels are set between mobile terminals and the gateways with external networks, and all communication is realized by way of these tunnels. When communication is implemented between mobile terminals, packets transmitted by the mobile terminals are transmitted to the gateways with the external networks by way of the tunnels, and then again returned to the mobile terminals of the communication partners from the gateways with the external networks by way of the tunnels.

[0007]

As a result, the technology of the prior art suffers from such problems as the considerable delay of the packets and the poor efficiency of circuit use due to wasted bandwidth within the mobile communication network.

[0008]

In addition, there is also the problem of wasted bandwidth within the network and the poor efficiency of circuit use when implementing multicast communication to a plurality of mobile terminals, because the multicast packets are copied and transmitted for each tunnel of a mobile terminal at the gateway with an external network.

[0009]

On the other hand, in the case of an IP based mobile communication network that employs Mobile IP and IPSEC, it is assumed that the mobile network and external networks are the IP network. The movement of terminals in this flat IP network is supported by Mobile IP. To further provide a private leased line connection capability, gateways are arranged between the mobile communication network and external networks, and tunnels are set between mobile terminals and the gateways by means of IPSEC.

[0010]

Thus, when a private leased line connection capability is offered in an IP based mobile communication network that uses Mobile IP and IPSEC, all packets are exchanged by way of tunnels, and the same problems therefore occur in this configuration as occur in GPRS.

[0011]

As a different configuration, when realizing communication between mobile terminals, it is also possible to directly set IPSEC tunnels between mobile

terminals without implementing return communication by way of gateways. This configuration, however, provides no solution for the problems encountered in multicast communication. There is also the problem that management of tunnels becomes problematic when there are numerous communication partner mobile terminals.

[0012]

In addition, in an IP based mobile communication network that uses Mobile IP and IPSEC, nodes in the mobile communication network can be freely accessed from the outside, and a security function is therefore necessary. For example, when realizing handover between access points, packets for handover requests and handover notifications between access points must be authenticated, and as a result, a security association must be established in advance for implementing authentication between access points. Such a method suffers from the problem that the management of the security association becomes troublesome with increase in the number of access points.

[0013]

When a virtual private network technology is used in the core network of a mobile communication network and connections are provided to external networks, the problem occurs in the prior art that the connection to the private network is cut off when a terminal moves.

[0014]

The present invention was realized in view of the above-described circumstances and has as its first object the provision of a mobile communication network system and mobile communication method for realizing an improvement in the efficiency of circuit use when implementing communication between mobile terminals.

[0015]

Another object of the present invention is to provide a mobile communication network system and mobile communication method for realizing an improvement in the efficiency of circuit use in the multicast communication of mobile terminals.

[0016]

It is yet another object of the present invention to provide a mobile communication network system and mobile communication method that eliminates the inconvenience of establishing a security association between mobile terminals or between nodes.

[0017]

Finally, it is another object of the present invention to provide a mobile communication network system and mobile communication method that can continue a private line connection between a mobile terminal and an external network without cutting off the private leased line connection when the mobile terminal implements handover.

[0018]

[Means to Solve the Problem]

In order to attain the object described above, according to the present invention,

a mobile communication network system that comprises a mobile communication network, a plurality of external networks, a plurality of mobile terminals, a plurality of gateways, and a plurality of access points, wherein said external networks and said mobile communication network are connected by said gateways, and said mobile terminals are connected to said mobile communication network by said access points, said system characterized in that

when packets are transmitted and received between said mobile terminals in said mobile communication network, the packets are communicated by way of virtual networks that are provided to correspond to each of said external networks on said mobile communication network, without passing said external networks.

[0019]

According to the present invention of claim 2,

a mobile communication network system that comprises a mobile communication network, a plurality of external networks, a plurality of mobile terminals, a plurality of gateways, and a plurality of access points, wherein said external networks and said mobile communication network are connected by said gateways, and said mobile terminals are connected to said mobile communication network by said access points, said system characterized in that

said mobile communication network is provided with means for offering virtual networks that correspond to each said external network,

said gateways are provided with means for connecting said external networks to corresponding said virtual networks,

said mobile terminals are provided with means for setting sessions with said access points for any of said external networks,

said access points are provided with means for transferring packets that have been received from any of said sessions to a virtual network that has been prepared for an external network that corresponds to that session,

said access points are provided with means for transferring packets, which have been received from said virtual network that corresponds to any external network, to a session that has been set for said external network by said mobile terminal that is the destination of these packets, and

private leased line connections are provided between said mobile terminals and said external networks, and when transmission or reception of packets is realized between said mobile terminals in said mobile communication network, the packets are communicated by way of virtual networks that are provided to correspond to each of said external networks on said mobile communication network.

[0020]

According to the mobile communication network system of the present invention of claim 3, characterized in that

when said mobile terminal is to be handed over from a current access point to which it is currently connected to a new access point, said current access point is provided with means for transferring information of all sessions that said mobile terminal has set to said new access point, and

said private leased line connection between said mobile terminal and said external network can be continued without interruption when said mobile terminal implements handover.

[0021]

According to the mobile communication network system of the present invention of claim 4, characterized in that

when said mobile terminal is to be handed over from a current access point to which it is currently connected to a new access point, said new access point is provided with means for acquiring information of all sessions that said mobile terminal has set from said current access point, and

said private leased line connection between said mobile terminal and said external network can be continued without interruption when said mobile terminal implements handover.

[0022]

According to the mobile communication network system of the present invention of claim 5, characterized in that

a mobility management node is arranged within said mobile communication network,

said mobility management node comprises a plurality of virtual mobility management nodes that are prepared for each of said external networks,

each of said virtual mobility management nodes is provided with means for transmitting and receiving packets only with a said virtual network that has been prepared for use by a corresponding external network,

said mobile terminals is provided with means for reporting positional information to said virtual mobility management node that corresponds to said external network to which the mobile terminal is to be connected,

each of said virtual mobility management nodes is further provided with means for holding positional information that has been reported from said mobile terminals and means for, when packets that are addressed to said mobile terminals are received, transferring these packets to positions that have been reported from said mobile terminals, and

said virtual networks, that are prepared to correspond to each of said external networks on said mobile communication network, manages the position of said mobile terminals.

[0023]

According to the mobile communication network system of the present invention of claim 6, characterized in that

said mobile communication network comprises a control/management virtual network,

said mobile communication network further comprises a means for transmitting and receiving, by way of said control/management virtual network, packets for control and management that are exchanged between nodes that are arranged within said mobile communication network and that include said access points and said mobility management nodes; and means for refusing packets for control and management that have been received from sources other than said control/management virtual network, and

the security of the communication among nodes arranged within said mobile communication network is ensured.

[0024]

According to the present invention of claim 7,

a mobile communication method in a mobile communication network comprises a mobile communication network, a plurality of external networks, a plurality of mobile terminals, a plurality of gateways, and a plurality of access points, wherein said external networks and said mobile communication network are connected by said gateways, and said mobile terminals are connected to said mobile communication network by said access points, said method characterized in that

a said mobile terminal sets a session for any of said external networks with said access point,

a said access point transfers packets that have been received from any said session to a virtual network that has been prepared for each of said external networks that corresponds to the session,

said access point transfers packets that have been received from said virtual network that corresponds to any external network to the session that has been set for use of said external network by said mobile terminal that is the

destination of the packets, and

private leased line connections are provided between said mobile terminals and said external networks, and when transmission or reception of packets is realized between said mobile terminals, the packets are communicated by way of virtual networks that are provided to correspond to each of said external networks on said mobile communication network.

[0025]

According to the mobile communication method of the present invention of claim 8, characterized in that

when said mobile terminal is to be handed over from a current access point to which it is currently connected to a new access point, said current access point transfers information of all sessions that said mobile terminal has set to said new access point.

[0026]

According to the mobile communication method of the present invention of claim 9, characterized in that

when said mobile terminal is to be handed over from a current access point to which it is currently connected to a new access point, said new access point acquires information of all sessions that said mobile terminal has set from said current access point.

[0027]

According to the mobile communication method of the present invention of claim 10, characterized in that

a mobility management node that is arranged within said mobile communication network comprises a plurality of virtual mobility management nodes that are prepared for each of said external networks,

each of said virtual mobility management nodes transmits and receives packets only with a said virtual network that has been prepared for use by a corresponding external network,

said mobile terminals report positional information to said virtual mobility management node that corresponds to said external network to which the mobile terminal is to be connected,

each of said virtual mobility management nodes holds positional information that has been reported from said mobile terminals and, when packets that are addressed to said mobile terminals are received, transfers these packets to positions that have been reported from said mobile terminals, and

said virtual networks, that are prepared to correspond to each of said external networks on said mobile communication network, manages the position of said mobile terminals.

[0028]

According to the mobile communication method of the present invention of claim 11, characterized in that

said mobile communication network comprises a control/management virtual network,

said mobile communication network transmits and receives, by way of said control/management virtual network, packets for control and management that are exchanged between nodes that are arranged within said mobile communication network and that include said access points and said mobility management nodes; and refuse packets for control and management that have been received from sources other than said control/management virtual network, and

the security of the communication among nodes arranged within said

mobile communication network is ensured.

[0029]

The above-described configuration and means enables the transmission and reception of packets between mobile terminals and external networks. Further, when communication is realized between mobile terminals that are connected to the same external network, packets that have been transmitted from a mobile terminal by way of the session for use by that external network, following output from an access point, are transferred by way of the virtual network that is for use by that external network directly to the access point to which the mobile terminal of the communication partner is connected. The packets are then delivered to the mobile terminal of the communication partner by way of the session that has been set by the mobile terminal of the communication partner for use by this external network. In addition, multicast packets are transmitted as normal multicast packets on the virtual network for use by this external network, and after arriving at the access point, are delivered to the mobile terminal by way of the session for use by this external network.

[0030]

[Description of the Preferred Embodiment]

Explanation next regards the details of preferable embodiments of the present invention with reference to the accompanying figures.

[0031]

(First Embodiment)

Explanation next regards the first embodiment with reference to Fig. 1. Fig. 1 shows the configuration of an overall network. The overall network is composed of: a plurality of external networks EX1, EX2, and EX3; mobile communication network MNW that is connected to these external networks; and

a plurality of mobile terminals X, Y, and Z that are connected to one or more of the external networks by way of mobile communication network MNW. The number of external networks and the number of mobile terminals are not limited to any specific number.

[0032]

Mobile communication network MNW is composed of: core network CN; a plurality of access networks ANa, ANb, and ANc; a plurality of radio drop lines; a plurality of wired drop lines; external network gateways EGW1, EGW2, and EGW3 that connect core network CN to the external networks; access network gateways AGWa, AGWb, and AGWc that connect core network CN to access networks; radio access points APa1, APa2, APb1, and APb2 that connect access networks and radio drop lines; and wired access points APc1 and APc2 that connect access networks to wired drop lines. The number of access networks and the number of access points are not limited to any specific numbers.

[0033]

Fig. 2 shows the logical configuration of core network CN. Core network CN uses an existing virtual private network technology such as multi-protocol label switching, and a plurality of virtual core networks are multiplexed on physical core network CN. In this example, virtual core network VCN1 for external network (1), virtual core network VCN2 for external network (2), virtual core network VCN3 for external network (3), and virtual core network VCNS for control/management are multiplexed.

[0034]

Fig. 3 shows the logical configuration of an access network. An access network uses an already existing virtual private network technology such as multiple-protocol label switching, a plurality of virtual access networks being

multiplexed on physical access network ANa. In this example, virtual access network VANA1 for external network (1), virtual access network VANA2 for external network (2), virtual access network VANA3 for external network (3), and virtual access network VANA4 for control/management are multiplexed.

[0035]

Fig. 4 shows the logical configuration of a radio drop line or a wired drop line. Communication channel CH1 and authentication channel CH2 are multiplexed on physical drop line LD. Sessions between each mobile terminal and each external network are multiplexed on communication channel CH1. In this case, session Sx1 between mobile terminal (x)X and external network (1) EX1, session Sx2 between mobile terminal (x)X and external network (2) EX2, and session Sy1 between mobile terminal (y)Y and external network (1) EX1 are multiplexed on communication channel CH1.

[0036]

As for the identification and multiplexing/separation of authentication channel CH2 and communication channel CH1, if a dedicated construction has been prepared for this purpose through drop line LD link technology, this construction is used. Alternatively, if such a construction has not been prepared through link technology, connection identifiers are used to multiplex authentication channel CH2 and communication channel CH1 in the case of connection-directive link technology, and packet type identifiers are used to multiplex authentication channel CH2 and communication channel CH1 in the case of connectionless link technology.

[0037]

As for the multiplexing and separation and session identification between mobile terminals and external networks, a dedicated construction that has been

prepared by the link technology for this purpose is used if such a construction exists. Alternatively, if such a construction has not been prepared in the link technology, connection identifiers are used to multiplex and separate sessions in the case of a connection-directive link technology, and packet-type identifiers and virtual network identifiers are used to multiplex and separate sessions in the case of connectionless link technology.

[0038]

Fig. 5 shows the configuration of an external network gateway. External network gateway EGW1 is composed of: external network-side transceiver TR01, external network gateway function EGF, external network gateway control function EGCF, virtual core network multiplexing-separation function CMUX1, and core network-side transceiver TR02.

[0039]

External network-side transceiver TR01 is connected to external network EX1 and transmits and receives packets.

[0040]

Core network-side transceiver TR02 is connected to core network CN and transmits and receives packets.

[0041]

Virtual core network multiplexing-separation function CMUX1 separates packets that have been received from core network-side transceiver TR02 for each virtual core network; supplies as input to external network gateway function EGF packets that have been transferred in on external network (1) virtual core network VCN1 that corresponds to connected external network EX1; or supplies as input to external network gateway control function EGCF packets that have been transmitted in on control/management virtual core network VCNS.

[0042]

Virtual core network multiplexing/separation function CMUX1 further transfers packets that have been received from external network gateway function EGF to the corresponding external network (1) virtual core network VCN1, transfers packets that have been received from external network gateway control function EGCF to control/management virtual core network VCNS, multiplexes these virtual core networks and supplies output to core network-side transceiver TR02.

[0043]

External network gateway function EGF performs routing and filtering of packets between external network EX1 and core network CN.

[0044]

External network gateway control function EGCF performs settings for filtering and path settings to external network gateway function EGF.

[0045]

Fig. 6 shows the configuration of an access network gateway. Access network gateway ANG_a is composed of: core network-side transceiver TR03_a, virtual core network multiplexing/separation function CMUX_a, external network (1) virtual access network gateway VAGW1_a, external network (2) virtual access network gateway VAGW2_a, external network (3) virtual access network gateway VAGW3_a, control/management virtual access network gateway VAGWS_a, virtual access network multiplexing/separation function AMUX1_a, and access network-side transceiver TR04_a.

[0046]

Core network-side transceiver TR03_a is connected to core network CN and transmits and receives packets.

[0047]

Access network-side transceiver TR04a is connected to access network ANa, and transmits and receives packets.

[0048]

Virtual core network multiplexing/separation function CMUXa separates packets that have been received from core network-side transceiver TR03a for each virtual core network, supplies packets that have been received from external network (1) virtual core network VCN1 as output to external network (1) virtual access network gateway VAGW1a, and performs similar processing for external network (2) virtual core network VCN2, external network (3) virtual core network VCN3, and control/management virtual core network VCNS.

[0049]

Virtual core network multiplexing/separation function CMUXa supplies packets that have been received as input from external network (1) virtual access network gateway VAGW1a to external network (1) virtual core network VCN1; performs similar processing for external network (2) virtual access network gateway VAGW2a, external network (3) virtual access network gateway VAGW3a, and control/management virtual access network gateway VAGWSa; multiplexes each virtual core network; and supplies output to core network-side transceiver TR03a.

[0050]

Virtual access network multiplexing/separation function AMUX1a separates packets that have been received as input from access network-side transceiver TR04 for each virtual access network; supplies packets that have been received from external network (1) virtual access network VANA1 as output to external network (1) virtual access network gateway VAGW1a; and performs

similar processing for external network (2) virtual access network VANa2, external network (3) virtual access network VANa3, and control/management virtual access network VANaS.

[0051]

Virtual access network multiplexing/separation function AMUX1a supplies packets that have been received as input from external network (1) virtual access network gateway VAGW1a as output to external network (1) virtual access network VANa1; performs similar processing for external network (2) virtual access network gateway VAGW2a, external network (3) virtual access network gateway VAGW3a, and control/management virtual access network gateway VAGWSa; multiplexes each virtual access network; and supplies output to access network-side transceiver TR04a.

[0052]

External network (1) virtual access network gateway function VAGW1a performs routing and filtering of packets between external network (1) virtual core network VCN1 and external network (1) virtual access network VANa1. The same holds true for external network (2) virtual access network gateway function VAGW2a and external network (3) virtual access network gateway function VAGW3a.

[0053]

In addition to the above-described functions, control/management virtual access network gateway function VAGWSa sets the filtering and sets the path to each of virtual access network gateway functions VAGW1a, VAGW2a, and VAGW3a.

[0054]

Fig. 7 shows the configuration of a mobile terminal. Mobile terminal X is

made up by: radio transceiver TR05, channel multiplexing/separation function CHMUX1, packet authentication function PAUTH1, session multiplexing/separation function SMUX, terminal authentication function TAUTH2, and communication entities ENT1 and ENT2 to a plurality of home networks.

[0055]

Radio transceiver TR05 transmits packets to and receives packets from radio drop lines.

[0056]

Channel multiplexing/separation function CHMUX1 performs multiplexing and separation of the authentication channels CCH and communication channels TCH on radio drop lines. Packets on authentication channels CCH are transmitted to and received from terminal authentication function TAUTH2, and packets on communication channels TCH are transmitted to and received from packet authentication function PAUTH1.

[0057]

Terminal authentication function TAUTH2 includes the mobile communication network information management table shown in Fig. 8, the home network information management table shown in Fig. 9, and the session information management table shown in Fig. 10.

[0058]

The mobile communication network information management table that is shown in Fig. 8 includes terminal ID 110 and mobile communication network—mobile terminal security association 111. Terminal ID 110 is an ID for uniquely identifying terminals within the mobile communication network. Mobile communication network—mobile terminal security association 111 is information for carrying out authentication between a mobile communication network and

mobile terminals. This information is assumed to be set in advance in mobile terminal X.

[0059]

The home network information management table that is shown in Fig. 9 holds one or more items of information that are each composed of the set of home network ID 210, home network terminal ID 220, and home network–mobile terminal security association 230. Home network ID 210 is an ID for uniquely identifying home networks. Terminal ID 220 is an ID for uniquely identifying terminals within a home network. Home network–mobile terminal security association 230 is information for carrying out authentication between a home network and a mobile terminal. This information is assumed to be set in advance in mobile terminal X.

[0060]

The session information management table that is shown in Fig. 10 includes one or more items of information that are each composed of the set of: home network ID 310, access point ID 320, access point–mobile terminal security association 330, session ID 340, and link information 350.

[0061]

This information is set when mobile terminal X performs terminal authentication, which is to be explained hereinbelow. Access point ID 320 is the ID of the access point to which the terminal is currently connected. Access point–mobile terminal security association 330 is information for authenticating, of packets that are transmitted and received between an access point and a terminal, packets other than authentication requests and authentication responses. Session ID 340 is ID for identifying the session that has been set with an access point, a session being prepared for each communication with a home

network. Link information 350 is information that is specific to each link that is used for identifying the session and for multiplexing/separation. Link information 350 depends on the link technology that is employed, and is, for example, a connection identifier or virtual private network identifier.

[0062]

Packet authentication function PAUTH1, based on previously described access point-mobile terminal security association 330, authenticates packets that have been received as input from channel multiplexing/separation function CHMUX1, and supplies only authenticated packets as output to session multiplexing/separation function SMUX.

[0063]

In addition, packet authentication function PAUTH1, based on the previously described access point-mobile terminal security association 330, appends an authentication code to packets that have been received as input from session multiplexing/separation function SMUX, and applies these packets as input to channel multiplexing/separation function CHMUX1.

[0064]

Session multiplexing/separation function SMUX, based on the previously described link information 350, determines the session that packets that have been received as input from packet authentication function PAUTH1 belong, and then turn over these packets to communication entity ENT1 or ENT2 of the corresponding home network. Session multiplexing/separation function SMUX further uses link information 350 of the corresponding session to make settings such that packets that have been handed over from the communication entities ENT1 and ENT2 of home networks are transmitted, and supplies the packets as output to packet authentication function PAUTH1.

[0065]

Explanation next regards the procedures of terminal authentication with reference to Fig. 13.

[0066]

When mobile terminal X initiates communication with a home network, terminal authentication function TAUTH2 generates authentication request packet 400 that is shown in Fig. 11 and transmits the authentication request packet to an access point. When generating an authentication request packet, the mobile terminal X does not set anything in old access point ID 401 when mobile terminal X first connects to the mobile communication network. When there is an access point that was previously connected, the mobile terminal sets ID 320 of this access point in old access point ID 401 (Step S131).

[0067]

Appropriate information is set in mobile terminal ID 402, home network ID 404, and home network mobile terminal ID 405 of a authentication request packet based on the mobile communication network information management table (Fig. 8) and the home network information management table (Fig. 9). Further, information that is necessary for a mobile communication network to authenticate a mobile terminal is set in mobile communication network mobile terminal authentication code 403 based on mobile communication network–mobile terminal security association 111, and information that is necessary for a home network to authenticate mobile terminal X is set in home network mobile terminal authentication code 406 based on home network–mobile terminal security association 230. Values are set as described above to generate authentication request packet 400 (Step 132), and authentication request packet 400 is then transmitted to access point (Step 133).

[0068]

In response, the access point returns the authentication response packet that is shown in Fig. 12. The returned authentication response packet is received (Step 134), and if authentication result 502 that is set in the authentication response packet indicates success, access point ID 501, access point-mobile terminal security association information 506, session ID 507, and link information 508 that are set in the authentication response packet are saved in session information management table (Step 135).

[0069]

Fig. 14 shows the configuration of a radio access point. Radio access point APa1 is made up from: access network-side transceiver TR06a, virtual access network multiplexing/separation function AMUX2a, session-external network mapping function MAP1, access point control/management function APM1, terminal authentication function TAUTH1, packet authentication function PAUTH2, session information handover function HOF1, session information management table SMT1, channel multiplexing/separation function CHMUX2, and radio transceiver TR07a.

[0070]

Access network-side transceiver TR06a is connected to access network ANa and transmits and receives packets.

[0071]

Radio transceiver TR07a transmits packets to and receives packets from radio drop lines.

[0072]

Virtual access network multiplexing/separation function AMUX2a separates packets that have been received as input from access network-side

transceiver TR06a for each virtual access network; applies packets that are on external network (1) virtual access network VANa1, external network (2) virtual access network VANa2, and external network (3) virtual access network VANa3 as input to session-external network mapping function MAP1; and applies packets that are on control/management virtual core network VANaS as input to access point control/management function APM1.

[0073]

Virtual access network multiplexing/separation function AMUX2a further multiplexes, on each virtual access network, packets that have been received as input from session-external network mapping function MAP1 and that are directed to external network (1) virtual access network VANa1, external network (2) virtual access network VANa2, and external network (3) virtual access network VANa3, and packets that have been received as input from access point control/management function APM1 and that are directed to control/management virtual access network VANaS, and supplies the result as output to access network-side transceiver TR06a.

[0074]

Channel multiplexing/separation function CHMUX2 separates signals that are received as input from radio transceiver TR07a for each channel, supplies the communication channels as input to packet authentication function PAUTH2, and supplies the authentication channels as input to terminal authentication function TAUTH1. Channel multiplexing/separation function CHMUX2 further multiplexes packets that have been received as input from packet authentication function PAUTH2 on the communication channel, multiplexes packets that have been received as input from terminal authentication function TAUTH1 on the authentication channel, and supplies the result as output to radio transceiver

TR07a.

[0075]

Session information management table SMT1 holds the content that is shown in Fig. 15. This content is: mobile terminal ID 610, external network ID 620 to which that terminal is connected, access point–mobile terminal security association 630 for authenticating packets from mobile terminals, session ID 640 for identifying sessions between mobile terminals and external networks, and link information 650 for identifying sessions; and the significance is equivalent to the information that is set in a mobile terminal. This information is set based on procedures that are to be explained hereinbelow by the terminal authentication function when a mobile terminal first connects to a network and carries out terminal authentication.

[0076]

Packet authentication function PAUTH2 authenticates packets that have been received as input from channel multiplexing/separation function CHMUX2 based on access point–mobile terminal authentication security association 630 that is held in session information management table 600 that is shown in Fig. 15, and supplies the packets as output to session–external network mapping function MAP1.

[0077]

Packet authentication function PAUTH2 further, based on access point–mobile terminal authentication security association 630 that is held in session information management table 600 that is shown in Fig. 15, appends an authentication code to packets that have been received as input from session–external network mapping function MAP1, and then supplies the packets as output to channel multiplexing/separation function CHMUX2.

[0078]

Session-external network mapping function MAP1 checks the packets that have been received as input from packet authentication function PAUTH2, and identifies the session based on link information 650 that is held in session information management table 600 that is shown in Fig. 15. Session-external network mapping function MAP1 then, based on external network ID 620 that corresponds to this session, distributes the packets to the appropriate external network virtual access network and applies the packets as input to virtual access network multiplexing/separation function AMUX2a.

[0079]

Session-external network mapping function MAP1 further checks packets that have been received as input from virtual access network multiplexing/separation function AMUX2a and identifies the session based on external network ID 620 and mobile terminal ID 610 that are held in session information management table 600 that is shown in Fig. 15. Session-external network mapping function MAP1 then uses the appropriate link information that corresponds to this session to perform settings for transmission, and supplies the packets as output to packet authentication function PAUTH2.

[0080]

When the mobile terminal that is the destination of packets that have been received from a mobile terminal is subordinate to the same access point, session-external network mapping function MAP1 simply transmits these packets back without alteration.

[0081]

Access point control/management function APM1 supplies packets that have been received as input from terminal authentication function TAUTH1 and

session information handover function HOF1 as output to virtual access network multiplexing/separation function AMUX2a; and separates packets that have been received as input from virtual access network multiplexing/separation function AMUX2a and then supplies the separated packets to terminal authentication function TAUTH1 and session information handover function HOF1.

[0082]

Explanation next regards the procedures for authentication of a terminal using the flow chart that is shown in Fig. 20.

[0083]

Upon receiving from channel multiplexing/separation function CHMUX2 the authentication request packet that is shown in Fig. 11 that has been received from a mobile terminal, terminal authentication function TAUTH1 generates the authentication request packet that is shown in Fig. 16 and supplies this packet to access point control/management function APM1 for transmission to the mobile communication network authentication server.

[0084]

Upon receiving from access point control/management function AMP1 the authentication response packet that is shown in Fig. 17 that has been received from the mobile communication network authentication server, terminal authentication function TAUTH1 first, if authentication result 802 of the authentication response packet indicates success, determines the ID used by the session between this mobile terminal X and external network 620 and determines link information 650 that is used by this session.

[0085]

Terminal authentication function TAUTH1 then saves the content of the authentication response packet in the corresponding field of session information

management table 600 that is shown in Fig. 15, and further, saves the generated session ID and link information in the corresponding fields of session information management table 600. Terminal authentication function TAUTH1 further generates the authentication response packet that is shown in Fig. 12 and supplies this packet as output to channel multiplexing/separation function CHMUX2 for transmission to a terminal.

[0086]

Explanation next regards a portion of the procedures of transferring session information with reference to the flow chart of Fig. 21.

[0087]

When the mobile terminal moves to the jurisdiction of another access point, session information handover function HOF1 generates the session information report packet that is shown in Fig. 18 based on the session information of that terminal (mobile terminal ID 610, external network ID 620, access point-mobile terminal authentication security association 630, session ID 640, and link information 650) that is saved in session information management table (Fig. 15), and supplies this session information report packet as output to access point control/management function APM1 for transmission to the access point of the destination of movement of the mobile terminal.

[0088]

Session information handover function HOF1 further, upon receiving session information report packet 900 that is shown in Fig. 18 from another access point, saves mobile terminal ID 902, external network ID 903, access point-mobile terminal authentication security association 904, session ID 905, and link information 906 in session information management table (Fig. 15).

[0089]

Explanation next regards a portion of the procedures of transferring session information using the flow chart of Fig. 20.

[0090]

When an old access point ID has been set in authentication request packet 700 from mobile terminal X, terminal authentication function TAUTH1 reports this information to session information handover function HOF1 instead of carrying out the previously described authentication procedures. Session information handover function HOF1 generates session information handover request packet 1000 that is shown in Fig. 19 and transmits this packet to the old access point.

[0091]

Session information handover function HOF1, upon receiving session information handover request packet 1000 that is shown in Fig. 19, transmits the session information handover report packet that is shown in Fig. 18 by the previously described procedures.

[0092]

In the case of a wired access point, the configuration is identical to the case for a radio access point with the exception that radio transceiver TR07a is a transceiver for a wired line, and explanation is therefore here omitted.

[0093]

Fig. 22 shows the configuration of a mobile communication network authentication server. Mobile communication network authentication server MAS1 is made up from: transceiver TR08, virtual core network multiplexing/separation function CMUXM, terminal authentication function TAUTH, external network determination function EDEC1, and home network authentication server communication function HASC1.

[0094]

Transceiver TR08 transmits packets to and receives packets from the core network CN.

[0095]

Virtual core network multiplexing/separation function CMUXM separates packets that have been received as input from transceiver TR08 for each virtual core network; supplies packets that are received from external network (1) virtual core network VCN1, external network (2) virtual core network VCN2, and external network (3) virtual core network VCN3 as output to home network authentication server communication function HASC1; and supplies packets that are received from control/management virtual core network VCNS as output to terminal authentication function TAUTH.

[0096]

Packets that have been received as input from home network authentication server communication function HASC1 and that are directed to external network (1) virtual core network VCN1, external network (2) virtual core network VCN2, and external network (3) virtual core network VCN3 are multiplexed for each virtual network with packets that have been received as input from terminal authentication function TAUTH and that are directed to control/management virtual core network VCNS and supplied as output to transceiver TR08.

[0097]

Explanation next regards the processing of packets relating to terminal authentication with reference to the flow chart shown in Fig. 27.

[0098]

Terminal authentication function TAUTH holds the terminal information

management table that is shown in Fig. 23. Upon receiving, from virtual core network multiplexing/separation function CMUXM, authentication request packet 700 that is shown in Fig. 16 that has been received from a radio access point or a wired access point, terminal authentication function TAUTH authenticates this packet based on terminal ID 1110 and mobile communication network–mobile terminal security association 1120 of the terminal information management table of Fig. 23. A successful authentication indicates that the mobile terminal has been authenticated in the mobile communication network.

[0099]

At this time, terminal authentication function TAUTH refers to external network determination function EDEC1 for the external network ID that corresponds to the home network ID. External network determination function EDC1 holds the home network–external network correspondence table that is shown in Fig. 24 and answers external network ID 1220 based on this table. At this time, terminal authentication function TAUTH requests home network authentication server communication function HASC1 for the authentication of the mobile terminal to the home network.

[0100]

In response, home network authentication server communication function HASC1 generates authentication request packet 1300 that is shown in Fig. 25, selects the corresponding external network virtual core network for transmitting to the authentication server of the home network, and supplies generated authentication request packet 1300 to virtual core network multiplexing/separation function CMUXM.

[0101]

In response, the home network authentication server authenticates the

packets based on the home network mobile terminal ID and the home network–mobile terminal security association that is held in the home network, and replies with authentication response packet 1400 that is shown in Fig. 26.

[0102]

Upon receiving as input authentication response packet 1400 that is shown in Fig. 26 from virtual core network multiplexing/separation function CMUXM, home network authentication server communication function HASC1 supplies this packet as output to terminal authentication function TAUTH. At this time, the mobile terminal has been authenticated in both the mobile communication network and the home network.

[0103]

Terminal authentication function TAUTH produces an access point–mobile terminal security association that is used for authenticating packets between the access point and the mobile terminal, generates authentication response packet 800 that is shown in Fig. 17, and supplies this packet as output to virtual core network multiplexing/separation function CMUXM for transmission to the access point.

[0104]

Explanation next regards the overall progression of mobile terminal authentication procedures that have been described to this point with reference to Fig. 28.

[0105]

Mobile terminal X first generates authentication request packet 400 that is shown in Fig. 11 and transmits this packet to access point APa1 by way of authentication channel M01.

[0106]

Access point APa1, having received this packet, generates authentication request packet 700 that is shown in Fig. 16 and transmits this packet to mobile communication network authentication server MAS by way of control/management virtual access network VANaS. Midway, access network gateway AGWa transfers the packet that has been received from control/management virtual access network VANaS to control/management virtual core network VCNS.

[0107]

Mobile communication network authentication server MAS, having received this packet, both authenticates the mobile terminal and generates authentication request packet 1300 that is shown in Fig. 25, and transmits this packet to home network authentication server HAS1 by way of external network virtual core network VCN1 that corresponds to the destination home network. Midway, external network gateway EGW1 transfers the packet that has been received from external network virtual core network VCN1 to external network (1) EX1.

[0108]

Home network authentication server HAS, having received this packet, both authenticates the mobile terminal and generates authentication response packet 1400 that is shown in Fig. 26 and transmits this packet to mobile communication network authentication server MAS. Midway, external network gateway EGW1 transfers the packet that has been received from external network EX1 to external network virtual core network VCN1.

[0109]

Mobile communication network authentication server MAS, having received this packet, both generates an access point-mobile terminal security

association and generates authentication response packet 800 that is shown in Fig. 17, and transmits this packet to access point APa1 by way of control/management virtual core network VCNS. Midway, access network gateway AGWa transfers the packet that has been received from control/management virtual core network VCNS to control/management virtual access network VANaS.

[0110]

Access point APa1, having received this packet, saves access point–mobile terminal security association 506, generates both session ID 507 and the corresponding link information 508 as well as authentication response packet 500 that is shown in Fig. 12, and further, transmits this packet to mobile terminal X by way of the authentication channel.

[0111]

Mobile terminal X, having received this packet, saves access point–mobile terminal security association 506, session ID 507, and the corresponding link information 508.

[0112]

By proceeding through the above-described procedures, the terminal authentication of the mobile terminal, the mobile communication network, and the home network is completed, and a session for communication with an external network, link information for this session, and a security association are set between a mobile terminal and an access point.

[0113]

Explanation next regards the flow of the transmission and reception of packets following terminal authentication based on Fig. 29.

[0114]

First, when communication entity ENT1 for each home network on mobile terminal X transmits packets, a session that corresponds to the home network is selected. Then, using the link information for this session, packets are transmitted on communication channel CH1 to access point APa1.

[0115]

In access point APa1, packet authentication is first realized for the packets that have been received. The external network that corresponds to the session to which the packets belong is then selected, the selected external network in this case being external network (1); and the packets are supplied as output to the virtual access network for this external network, the virtual access network in this case being VANa1.

[0116]

If the communication partner is subordinate to the same virtual access network, these packets are transmitted to the access point to which the communication partner is connected. If the communication partner is under a different access network or in an external network, the packets are supplied as output by way of access network gateway AGWa to the virtual core network, in this case VCN1, that corresponds to the virtual access network, in this case VANa1.

[0117]

Further, if the communication partner is under the jurisdiction of another access network, the packets are transferred to that access network gateway by way of a virtual core network, in this case VCN1. If the communication partner is in an external network, the packets are supplied as output to the external network by way of an external network gateway, in this case EGW1.

[0118]

The flow of processing when a mobile terminal receives packets is next shown.

[0119]

When packets from external network (1) EX1 arrive, these packets are transferred on the corresponding virtual core network VCN1. These packets are transferred on the corresponding virtual access network VANa1 by way of access network gateway AGWa of the access network in which the mobile terminal is currently located. When access point APa1 receives the packets from the virtual access network for a particular external network, a session is selected based on this external network and the ID of the mobile terminal that is the destination of the packets.

[0120]

A packet authentication code is then appended to the packets, and, using link information that corresponds to the session, the packets are then transmitted on communication channel CH1 to mobile terminal X.

[0121]

Upon receiving the packets, mobile terminal X carries out packet authentication, and then, based on the session to which the packets belong, passes the packets to the communication entity for the appropriate home network.

[0122]

As one example, Fig. 30 shows the procedures for positional registration of mobile terminal X when mobility management node MA1 is arranged in external network EX1. Because this processing is performed through the use of an already existing technology such as mobile IP, only a summary will be shown. Positional registration request packet M30 is transmitted to mobility management

node MA1 according to the previously described flow of packets.

[0123]

Upon receiving this packet, mobility management node MA1 holds the position of the terminal and returns positional registration response packet M31 to mobile terminal X. Packets that are transmitted from other terminals addressed to this mobile terminal are first delivered to mobility management node MA1, and based on the positional information that is registered, the mobility management node transfers these packets to mobile terminal X.

[0124]

Fig. 31 and Fig. 32 show the procedures for a case in which a mobile terminal is handed over from one access point to another access point.

[0125]

There are three forms for this handover: (1) a form in which the mobile terminal determines that handover to a new access point will be carried out, and reports the new access point to the old access point to which it is currently connected; (2) a form in which the access point to which the mobile terminal is connected determines the new access point to which the mobile terminal is to be handed over and reports this to the mobile terminal; and (3) a form in which, after the mobile terminal has been connected to the new access point, the mobile terminal then reports to the new access point the old access point to which it was previously connected.

[0126]

Fig. 31 shows the procedures for first two of these forms. When old access point APo itself determines the new access point APn that is the handover destination of mobile terminal X, or when the new access point APn that is the handover destination is notified from mobile terminal X, the old access

point APo before movement extracts all of the session information for this mobile terminal from the session information table, produces a session information handover report packet that is shown in Fig. 18, and transmits this packet to new access point APn after movement.

[0127]

If the new access point is subordinate to another access network at this time, the packet is transferred by way of an access network gateway. The new access point APn sets this information in a session information management table.

[0128]

Fig. 32 shows the procedures for the third form of the three handover forms described above. When the new access point APn after movement receives the authentication request packet that is shown in Fig. 11 from the mobile terminal, access point APn, based on the old access point ID that is set in this packet, transmits the session information handover request that is shown in Fig. 19 to access point APo, which is the old access point before movement.

[0129]

Old access point APo extracts all session information for this mobile terminal from this session information table, produces the session information handover report packet that is shown in Fig. 18, and transmits this packet to access point APn, which is the new access point after movement. The new access point sets this information in a session information management table.

[0130]

By means of the above-described procedures, a mobile terminal can continue communication with the same external network when moving to the jurisdiction of another access point.

[0131]

(Second Embodiment)

Explanation next regards the second embodiment of the present invention with reference to Fig. 33. The configuration of the mobile communication network of Fig. 33 is essentially identical to that of Fig. 1, with the exception of the addition of local mobility management node LMA1 to the core network.

[0132]

Fig. 34 shows the configuration of local mobility management node LMA1. Local mobility management node LMA1 is made up from: transceiver TR09, virtual core network multiplexing/separation function CMUXL, external network (1) virtual local mobility management node VLMA1, external network (2) virtual local mobility management node VLMA2, external network (3) virtual local mobility management node VLMA3, and control/management virtual local mobility management node VLMA5.

[0133]

Transceiver TR09 is connected to core network CN and transmits and receives packets.

[0134]

Virtual core network multiplexing/separation function CMUXL separates packets that are received as input from core network-side transceiver TR09 for each virtual core network, supplying packets that have been received from external network (1) virtual core network VCN1 to external network (1) virtual local mobility management node VLMA1, and carrying out similar operations for external network (2) virtual core network VCN2, external network (3) virtual core network VCN3, and control/management virtual core network VCNS.

[0135]

Virtual core network multiplexing/separation function CMUXL further supplies packets that have been received as input from external network (1) virtual local mobility management node VLMA1 as output to external network (1) virtual core network VCN1, performs similar processing for external network (2) virtual local mobility management node VLMA2, external network (3) virtual local mobility management node VLMA3, and control/management virtual local mobility management node VLMA5, multiplexes each virtual core network, and supplies the result to transceiver TR09.

[0136]

Each of the virtual local mobility management nodes employs an already existing technology such as Mobile IP, and these procedures are next described using Fig. 35. Mobile terminal X transmits a positional registration request to external network (1) virtual local mobility management node VLMA1. External network (1) virtual local mobility management node VLMA1, having received this request, holds the positional information of the mobile terminal and transmits a positional registration response.

[0137]

When packets addressed to mobile terminal X are sent in, external network (1) virtual local mobility management node VLMA1 also transfers these packets to the position that was reported from mobile terminal X, whereby a function for supporting the movement of the terminal on the virtual network is provided.

[0138]

Although the present invention has been described hereinabove by presenting preferable embodiments and working examples, the present invention is not necessarily limited to the above-described embodiments and working

examples and is open to various modifications within the scope of the technical concept of the invention.

[0139]

[Effects of the Invention]

The present invention as described hereinabove can realize the following effects:

[0140]

When realizing communication between mobile terminals in the prior art, packets were transferred by way of external network gateways. In contrast, when realizing communication between mobile terminals in the present invention, communication is realized by returning at the access point when each of the mobile terminals is under the jurisdiction of the same access point, communication is realized by way of the access network when each of the mobile terminals is under the jurisdiction of the same access network, and communication is realized by way of a core network when each of the mobile terminals is under the jurisdiction of different access networks, whereby the efficiency of circuit use of core networks and access networks can be improved.

[0141]

Moreover, regarding multicast communication, the efficiency of circuit use in the prior art was poor because multicast packets were copied a number of times equal to the number of mobile terminals that receive multicast packets in an external network gateway and then transferred to mobile terminals on tunnels. In the present invention, however, packets on core networks or access networks are transferred using multicast, and the efficiency is therefore improved.

[0142]

In addition, according to the present invention, private networks are

formed by virtual core networks and virtual access networks, whereby the inconvenience of establishing a security association between mobile terminals can be eliminated.

[0143]

According to the present invention, moreover, communication between nodes on a mobile communication network is protected by means of control/management virtual core networks and virtual access networks, whereby the inconvenience of establishing a security association between nodes can be eliminated.

[0144]

Finally, according to the present invention, the private leased line connection between a mobile terminal and an external network can be continued without interruption when mobile terminals implement handover.

[Brief Description of the Drawings]

[Fig. 1] A diagram showing the configuration of an overall network according to the first embodiment of the present invention.

[Fig. 2] A diagram showing the relation between a core network and a virtual core network that is multiplexed on the core network in the first embodiment of the present invention.

[Fig. 3] A diagram showing the relation between a core network and a virtual access network that is multiplexed on the core network in the first embodiment of the present invention.

[Fig. 4] A diagram showing the relation between radio or wired drop lines, authentication channels that are multiplexed on these lines, and communication channels; and the relation between mobile terminals that are multiplexed on communication channels and the sessions between external networks.

[Fig. 5] A diagram showing the configuration of an external network gateway in the first embodiment of the present invention.

[Fig. 6] A diagram showing the configuration of an access network gateway in the first embodiment of the present invention.

[Fig. 7] A diagram showing the configuration of a mobile terminal in the first embodiment of the present invention.

[Fig. 8] A diagram showing the configuration of a mobile communication network information management table that is held by a mobile terminal.

[Fig. 9] A diagram showing the configuration of a home network information management table that is held by a mobile terminal.

[Fig. 10] A diagram showing the configuration of a session information management table that is held by a mobile terminal.

[Fig. 11] A diagram showing the content of an authentication request packet that is transmitted to an access point by a mobile terminal.

[Fig. 12] A diagram showing the content of an authentication response packet that is transmitted to a mobile terminal by an access point.

[Fig. 13] A diagram showing a flow chart showing the procedures for terminal authentication.

[Fig. 14] A diagram showing the configuration of an access point.

[Fig. 15] A diagram showing the configuration of a session information management table of an access point.

[Fig. 16] A diagram showing the content of an authentication request packet that is transmitted to a mobile communication network authentication server by an access point.

[Fig. 17] A diagram showing the content of an authentication response packet that is transmitted to an access point by a mobile communication network

authentication server.

[Fig. 18] A diagram showing the content of a session information report packet that is transmitted to a new access point by the old access point.

[Fig. 19] A diagram showing the content of a session information request packet that is transmitted to the old access point by the new access point.

[Fig. 20] A diagram showing a flow chart showing the processing of packets relating to terminal authentication in an access point.

[Fig. 21] A diagram showing a flow chart showing the processing for transmission of session information handover report packets in an access point.

[Fig. 22] A diagram showing the configuration of a mobile communication network authentication server.

[Fig. 23] A diagram showing the configuration of a mobile terminal information management table.

[Fig. 24] A diagram showing the configuration of a home network-external network correspondence table.

[Fig. 25] A diagram showing the content of an authentication request packet that is transmitted to a home network authentication server by a mobile communication network authentication server.

[Fig. 26] A diagram showing the content of an authentication response packet that is transmitted to a mobile communication network authentication server by a home network authentication server.

[Fig. 27] A diagram showing a flow chart showing the procedures of terminal authentication in a mobile communication network authentication server.

[Fig. 28] A diagram showing the procedures of terminal authentication.

[Fig. 29] A diagram showing the flow of transmission and reception of packets.

[Fig. 30] A diagram showing the flow of positional registration to a mobility management node of a home network.

[Fig. 31] A diagram showing the procedures for transferring session information to a new access point from the old access point.

[Fig. 32] A diagram showing the procedures for requesting transfer of session information from the new access point to the old access point.

[Fig. 33] A diagram showing the overall configuration in the second embodiment of the present invention.

[Fig. 34] A diagram showing the configuration of a local mobility management node in the second embodiment of the present invention.

[Fig. 35] A diagram showing the procedures for positional registration to a local mobility management node.

[Description of Numbers]

Exn: external network (n)

MNW: mobile communication network

CN: core network

MA_n: mobility management node (n)

HAS_n: home network authentication server (n)

EGW_n: external network gateway (n)

MAS: mobile communication network authentication server

AGW_a: access network gateway (a)

AN_a: access network (a)

AP_{a-n}: radio access point (a-n)

X, Y, Z: mobile terminal

LMA1: local mobility management node

VCN_n: virtual core network for external network (n)

VCNS: virtual core network for control/management
VANan: virtual access network (a) for external network (n)
VANaS: virtual access network (a) for control/management
San: session between mobile terminal (a) and external network (n)
CH1: communication channel
CH2: authentication channel
LD: wired drop line or radio drop line
EGWn: external network gateway (n)
EGF: external network gateway function
EGCF: external network gateway control function
CMUX1: virtual core network multiplexing-separation function
TR01: external network-side transceiver
TR02: core network-side transceiver
AMUX1a: virtual access network multiplexing/separation function
TR03a: core network-side transceiver
TR04a: external network-side transceiver
ANGa: access network gateway (a)
VAGWna: virtual access network gateway (a) for external network (n)
VAGWSa: virtual access network gateway (a) for control/management
ENTn: communication entity to home network (n)
TAUTH2: terminal authentication function (mobile terminal)
SMUX: session multiplexing/separation function
CHMUX1: channel multiplexing/separation function (mobile terminal)
PAUTH1: packet authentication function (mobile terminal)
TR05: radio transceiver (mobile terminal)
TCH: communication channel (mobile terminal)

CCH: authentication channel (mobile terminal)
TAUTH1: terminal authentication function
MAP1: session-external network mapping function
SMT1: session information management table
APM1: access point control/management function
AMUX2a: virtual access network multiplexing/separation function
HOF1: session information handover function
PAUTH2: packet authentication function
CHMUX2: channel multiplexing/separation function
TR06a: access network-side transceiver
TR07a: radio transceiver
EDEC1: external network determination function
TAUTH: terminal authentication function
HASC1: home network authentication server communication function
CMUXM: virtual core network multiplexing/separation function
TR08: transceiver
LMA1: local mobility management node

Fig.1

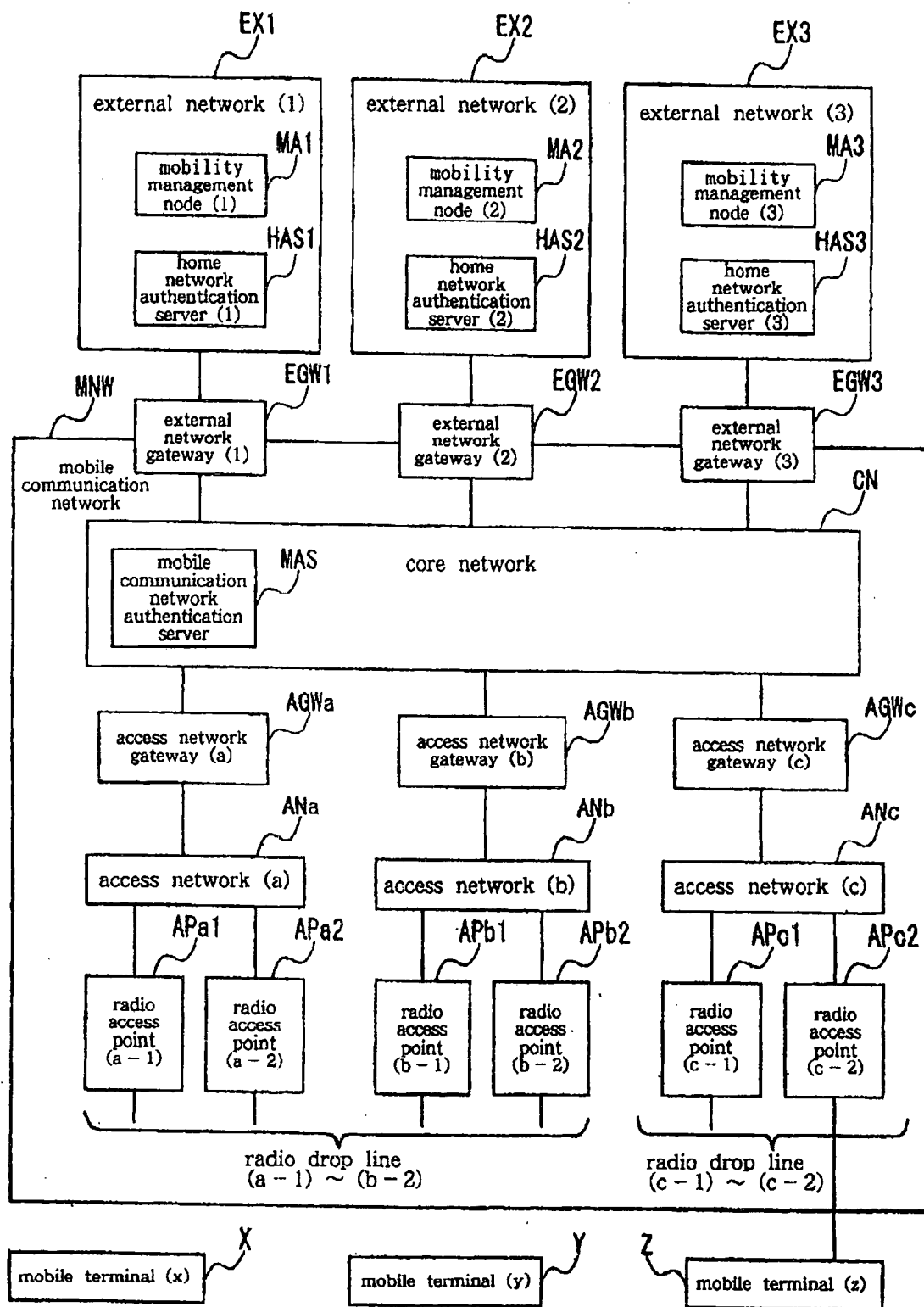


Fig. 2

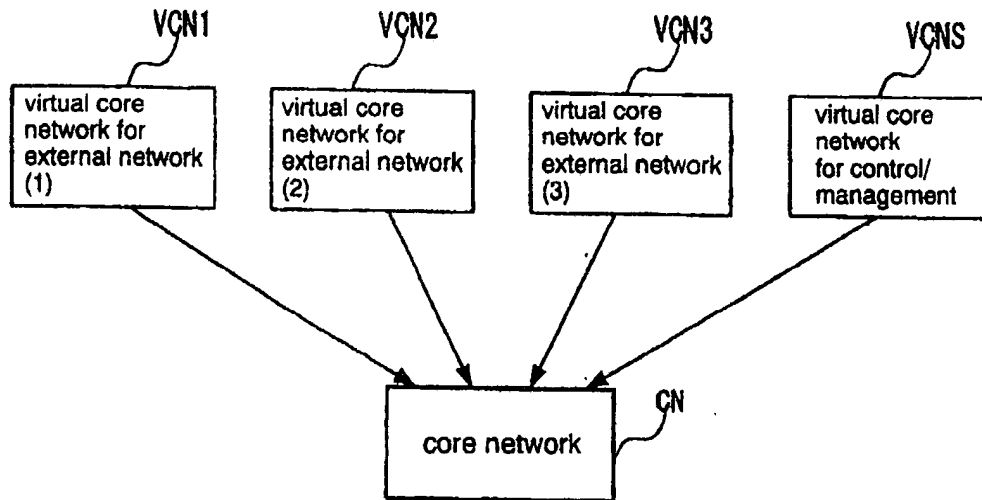


Fig. 3

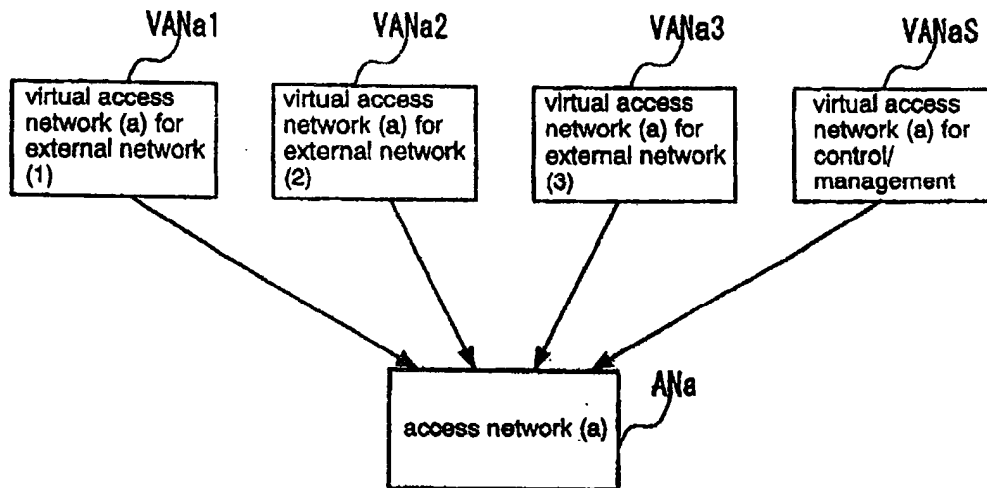


Fig. 4

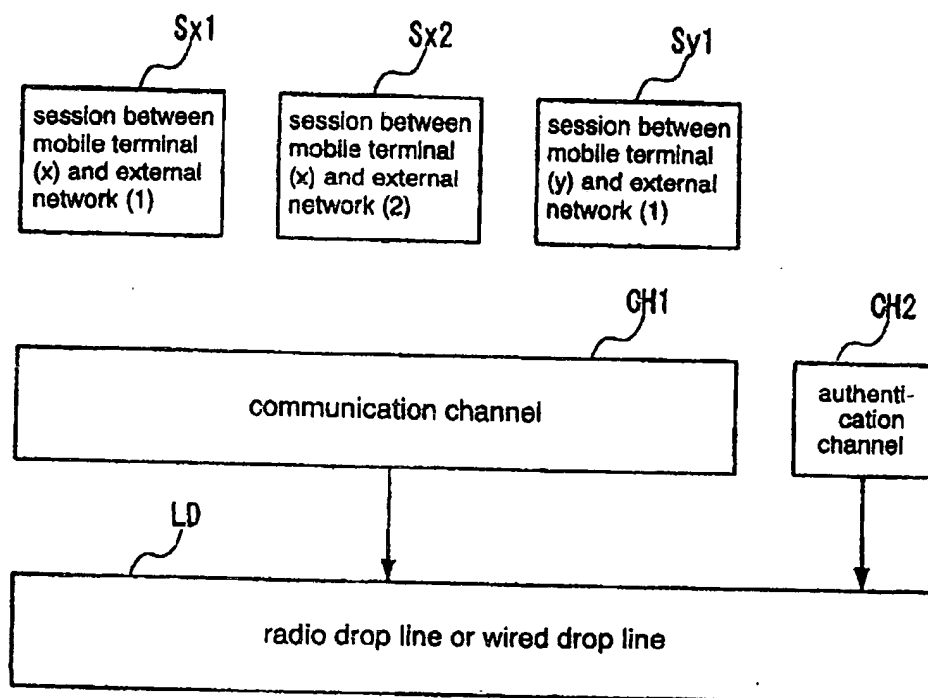


Fig. 5

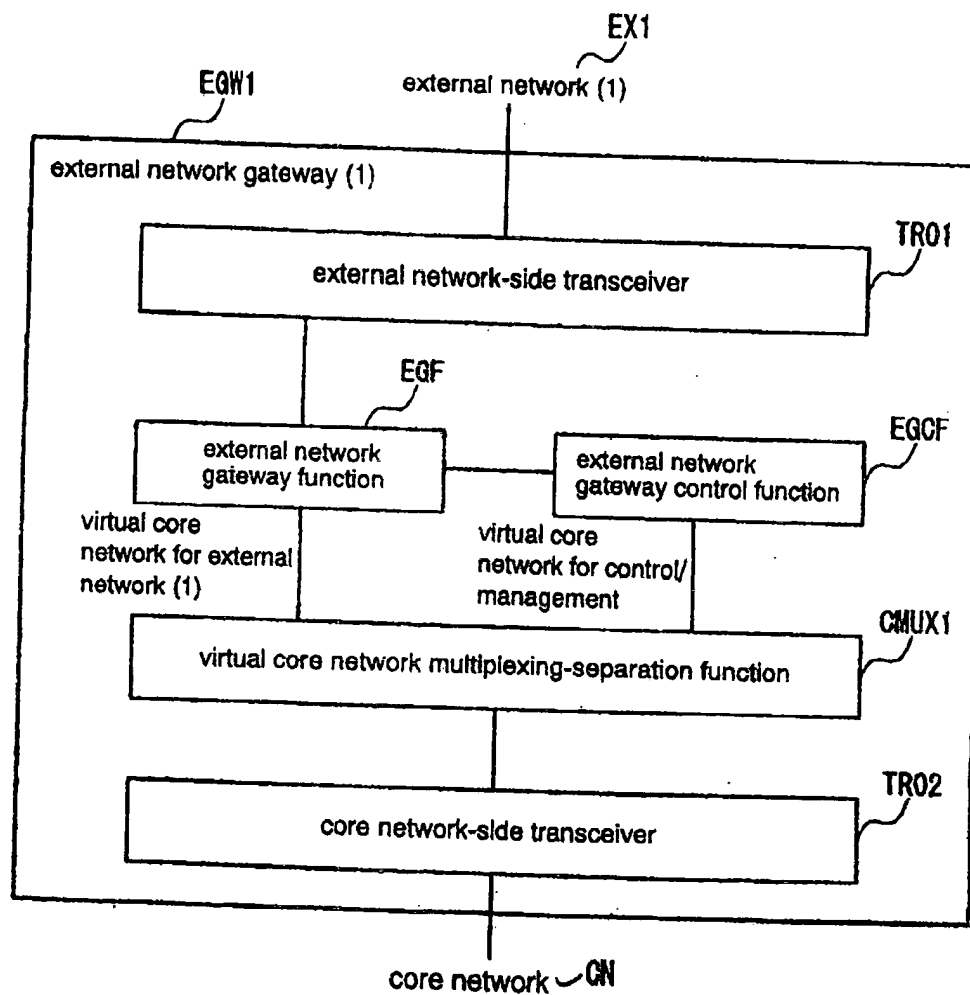


Fig. 6

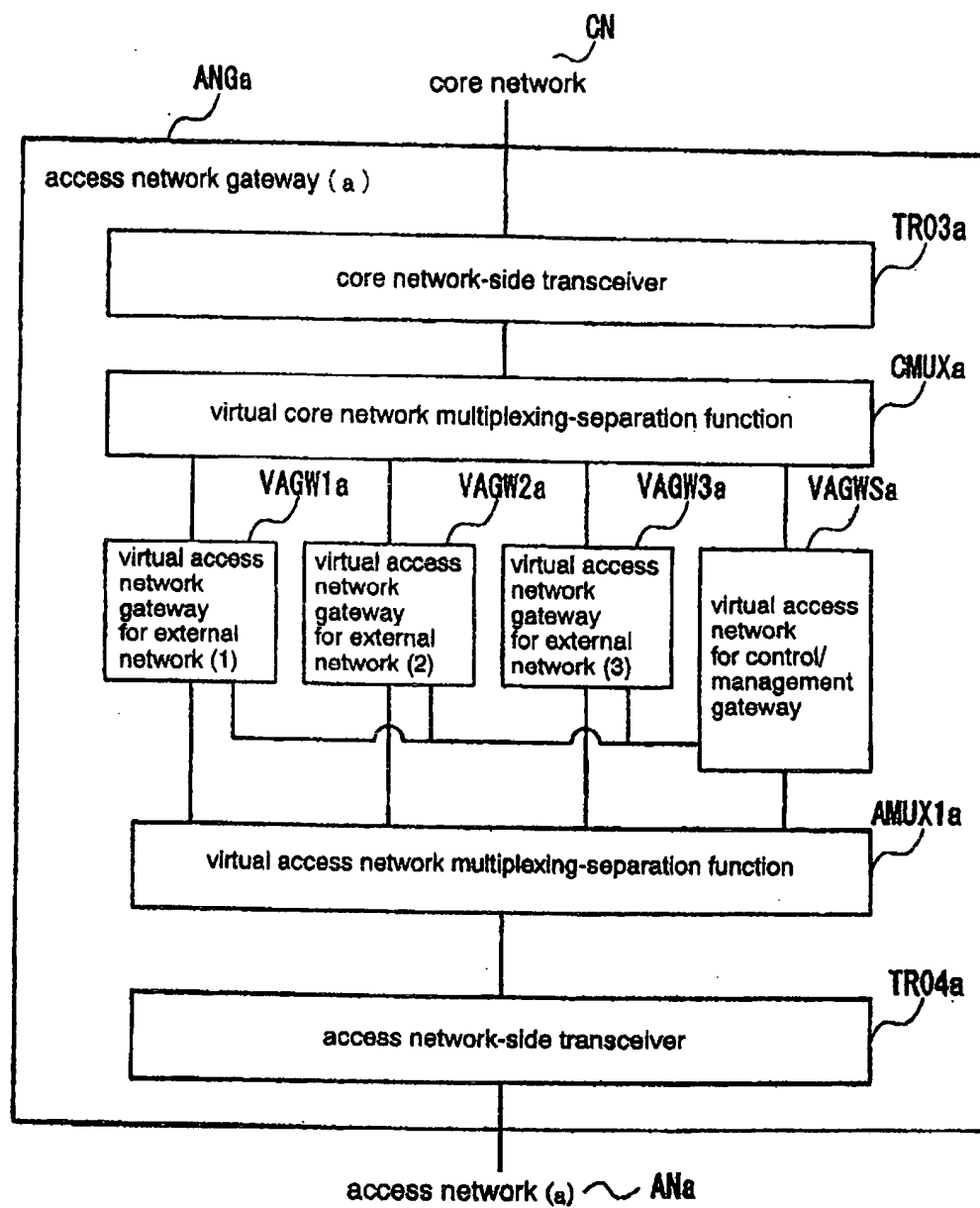


Fig. 7

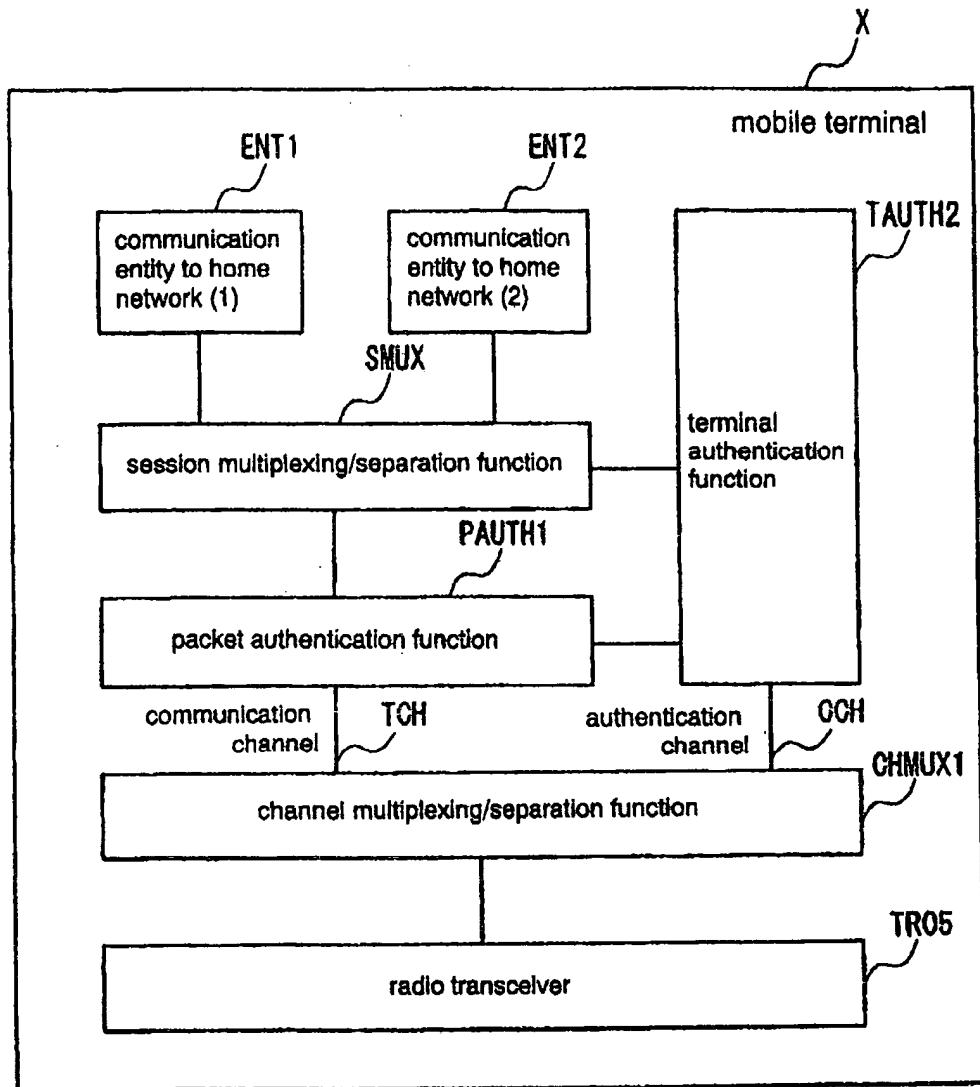


Fig. 8

mobile communication network information management table

terminal ID	110
mobile communication network-mobile terminal security association (SA)	111

Fig. 9

200 home network information management table

210	home network ID	220 mobile terminal ID for home network	230 home network-mobile terminal SA
211	home network #1	ID # 1 221	Home SA # 1 231
212	home network #2	ID # 2 222	Home SA # 2 232

Fig. 10

300 session information management table

310	home network ID	320 access point ID	330 access point - terminal SA	340 session ID	350 link information
311	home network #1	AP#1	AP-SA#1	S-ID#1	LINK#1
312	home network #2	AP#1	AP-SA#2	S-ID#2	LINK#2

322 321 332 331 342 341 352 351

Fig. 11

400 authentication request packet

old radio access point ID	401
terminal ID	402
terminal authentication code for mobile communication network	403
home network ID	404
terminal ID for home network	405
terminal authentication code for home network	406

Fig. 12

500 authentication response packet

access point ID	501
authentication result	502
mobile terminal ID	503
home network ID	504
mobile terminal ID for home network	505
access point-mobile terminal SA	506
session ID	507
link information	508

Fig.13

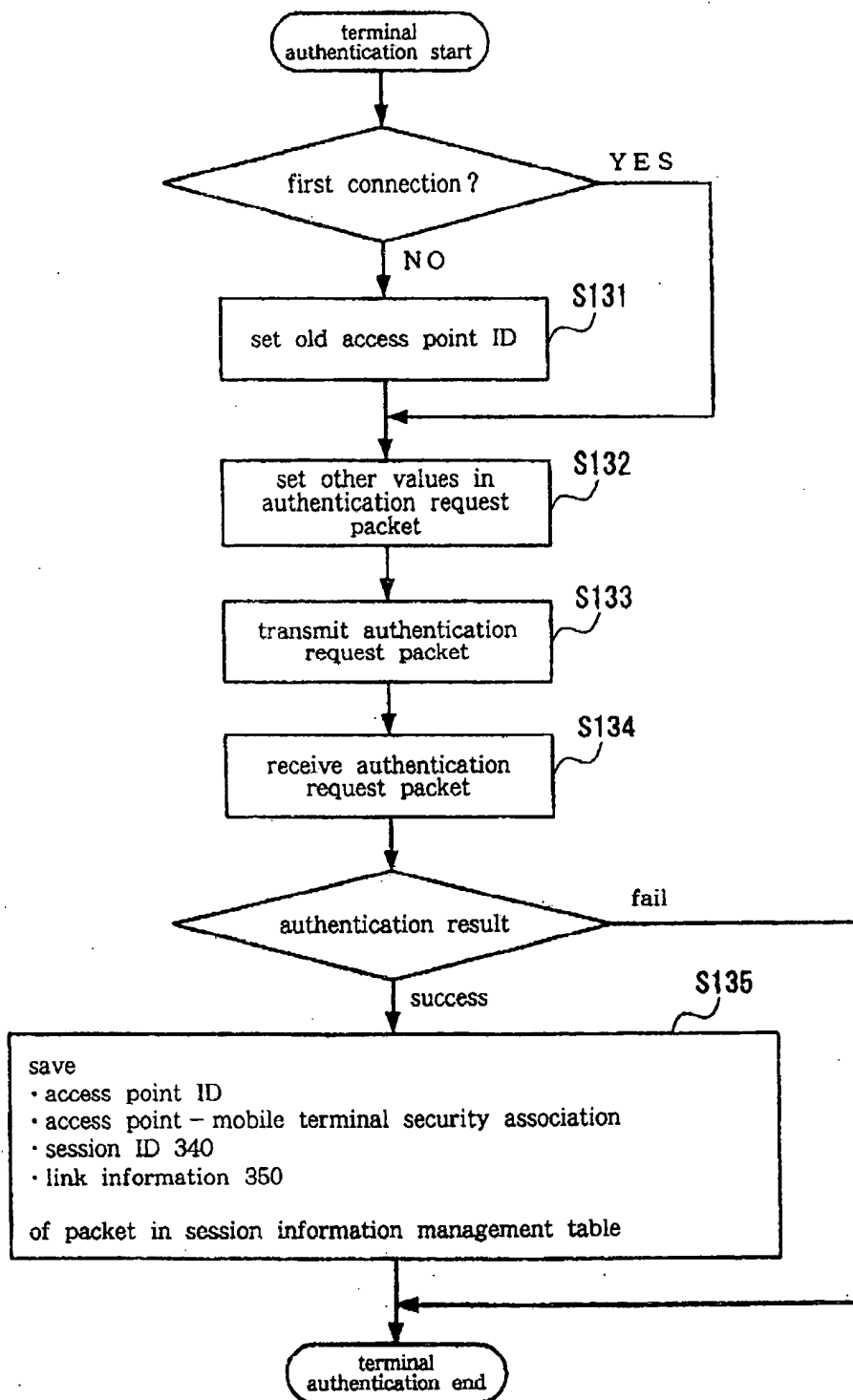


Fig. 14

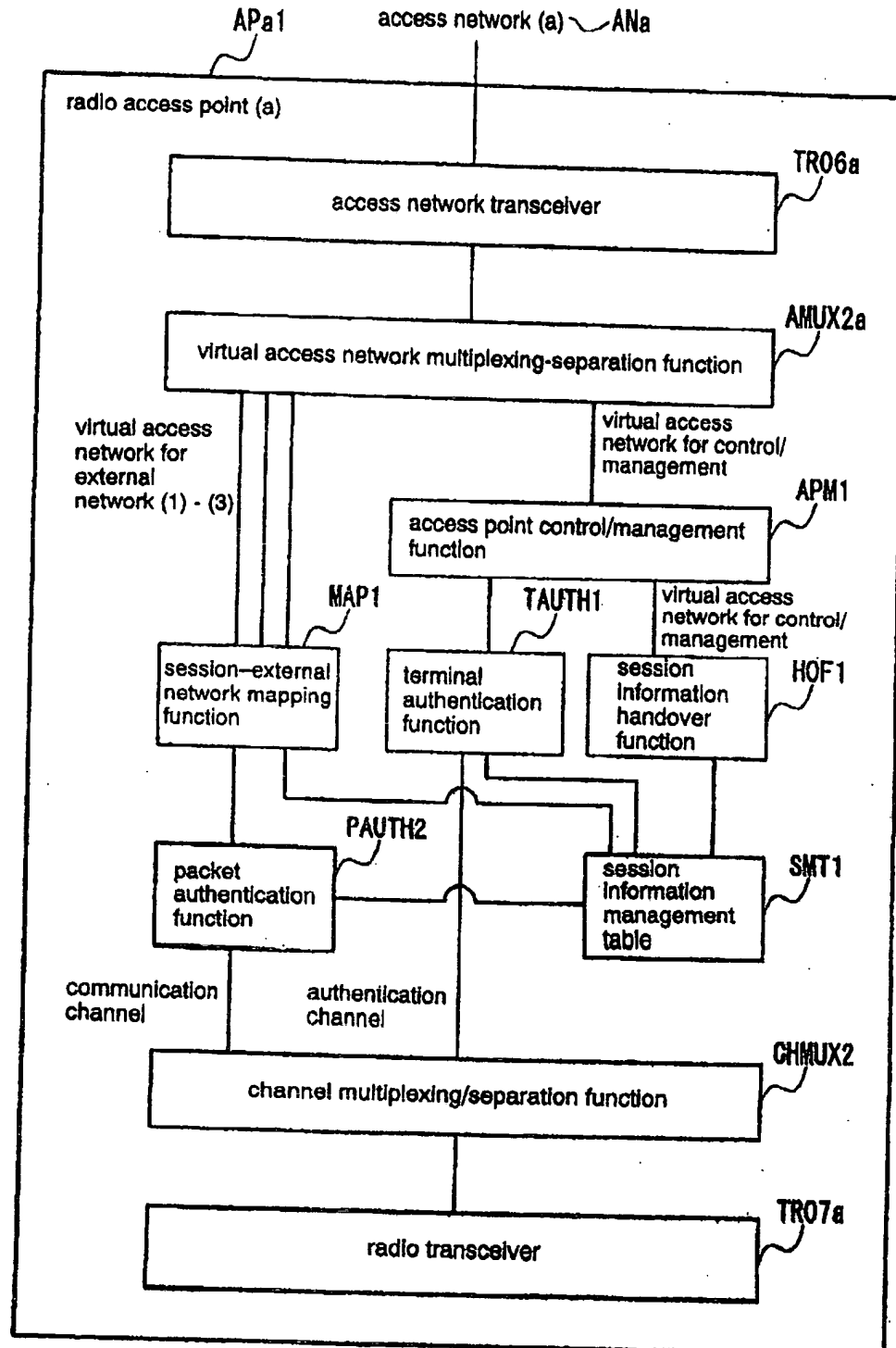


Fig. 15

600 session information management table

mobile terminal ID 610	external network ID 620	access point – mobile terminal SA 630	session ID 640	link information 650
mobile terminal #1 611	external network #1 621	SA # 1 631	session #1 641	link information #1 651
mobile terminal #1 612	external network #2 622	SA # 2 632	session #2 642	link information #2 652
mobile terminal #2 613	external network #1 623	SA # 1 633	session #1 643	link information #1 653

Fig. 16

700 authentication request packet

radio access point ID	701
mobile terminal ID	702
mobile terminal authentication code for mobile network	703
home network ID	704
mobile terminal ID for home network	705
mobile terminal authentication code for home network	706

Fig. 17

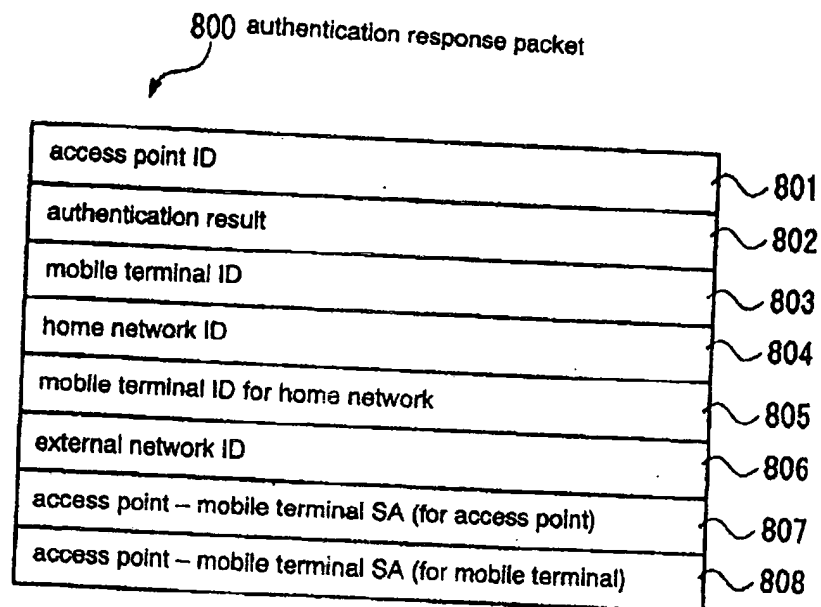


Fig. 18

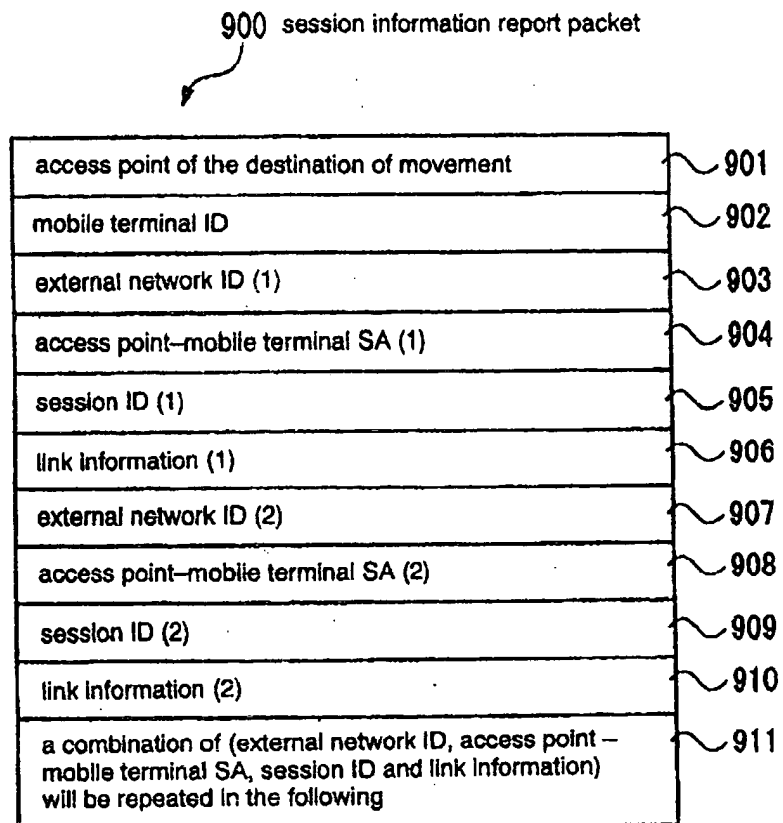


Fig. 19

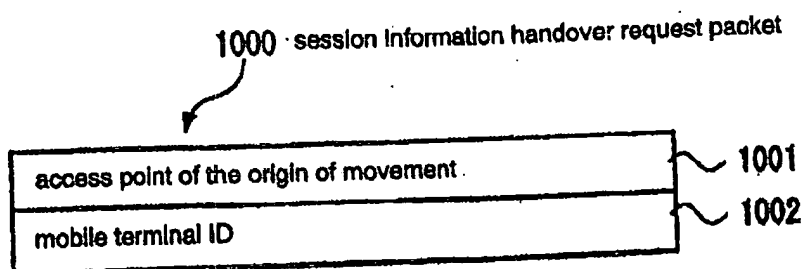


Fig.20

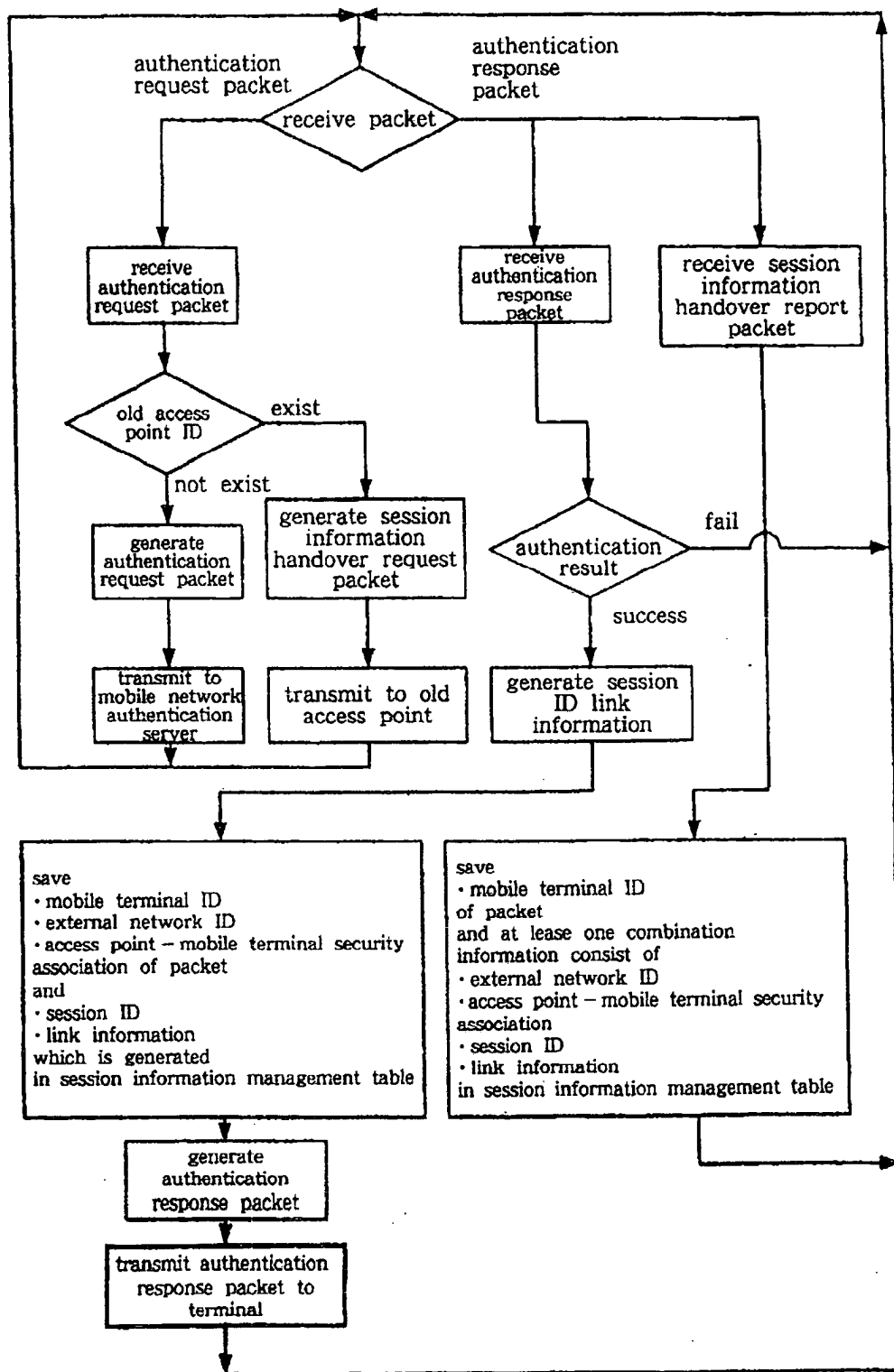


Fig. 21

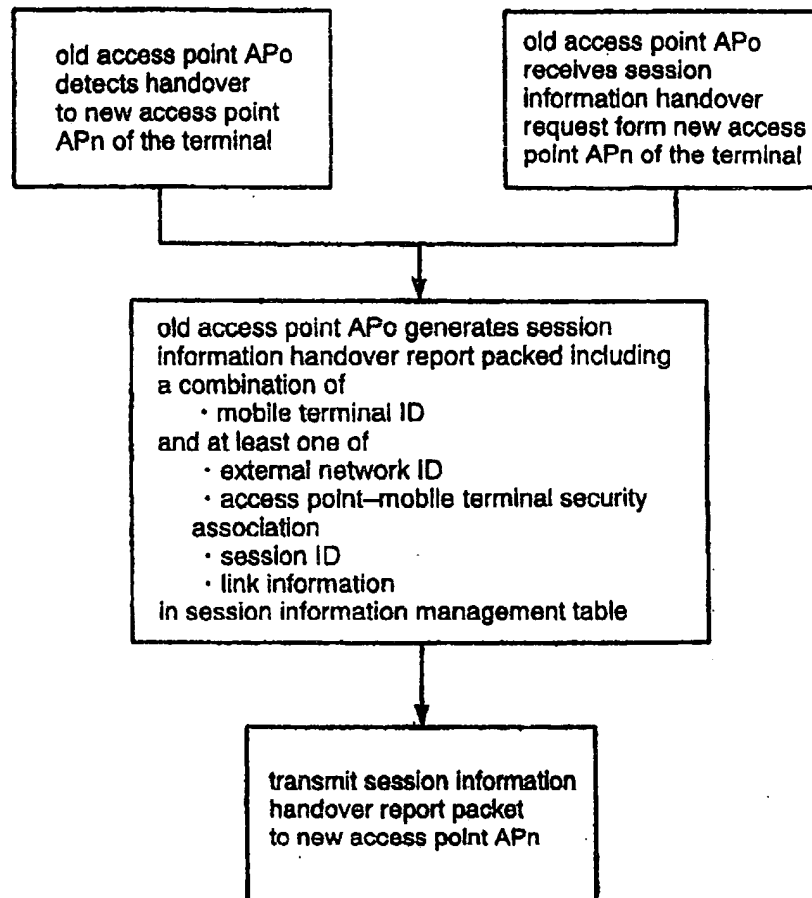


Fig. 22

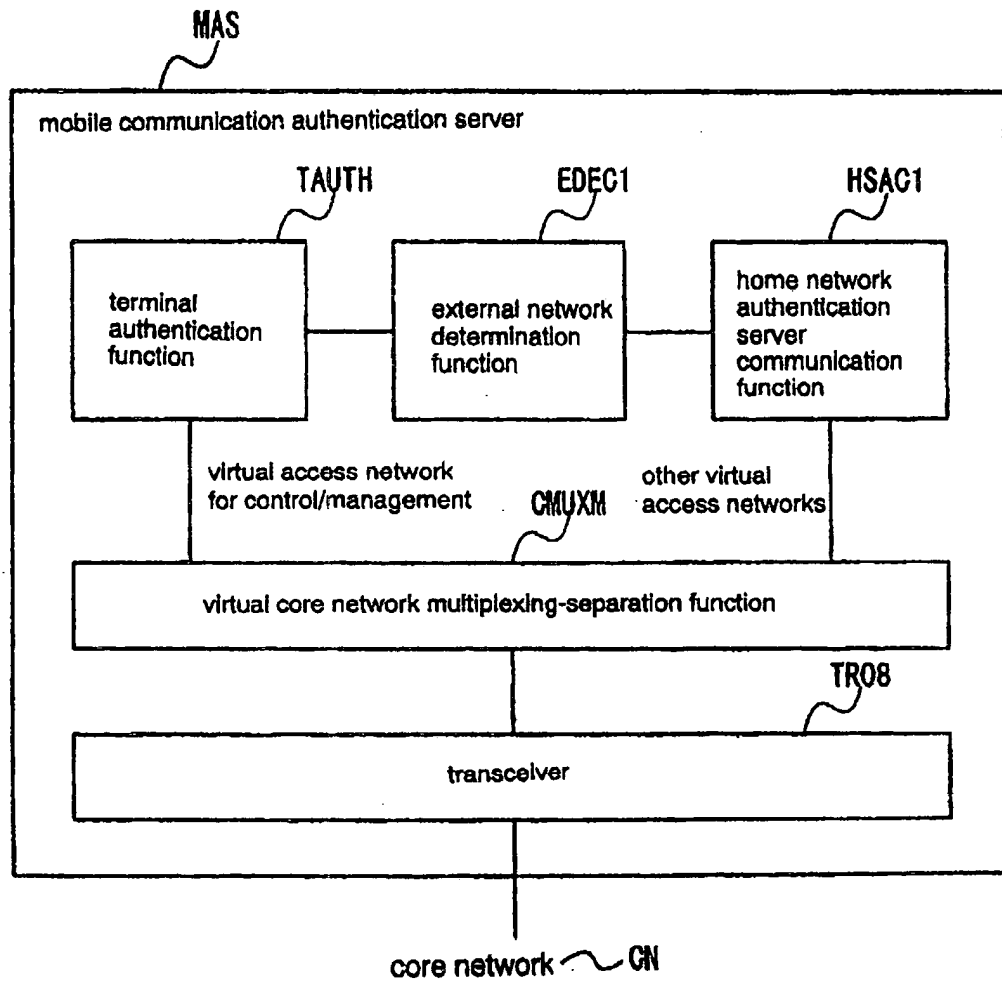


Fig. 23

1100 terminal information management table

mobile terminal ID (1110)	mobile communication server – mobile terminal SA (1120)	access point – mobile terminal SA (1130)
mobile terminal #1 (1111)	Home SA # 1 (1121)	SA # 1 (1131)
mobile terminal #2 (1112)	Home SA # 2 (1122)	SA # 2 (1132)

Fig. 24

1200 home network – external network correspondence table

home network ID (1210)	external network ID (1220)
home network #1 (1211)	external network #1 (1221)
home network #2 (1212)	external network #2 (1222)

Fig. 25

1300 authentication request packet

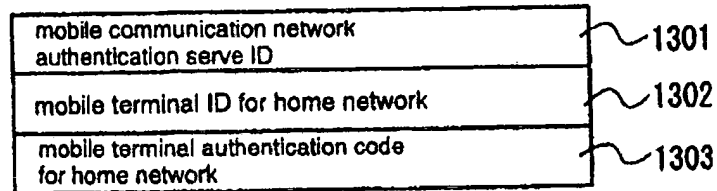


Fig. 26

1400 authentication response packet

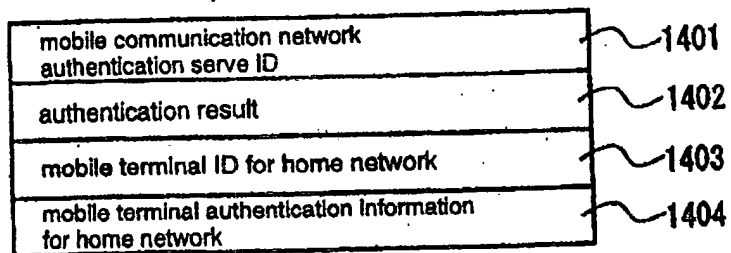


Fig.27

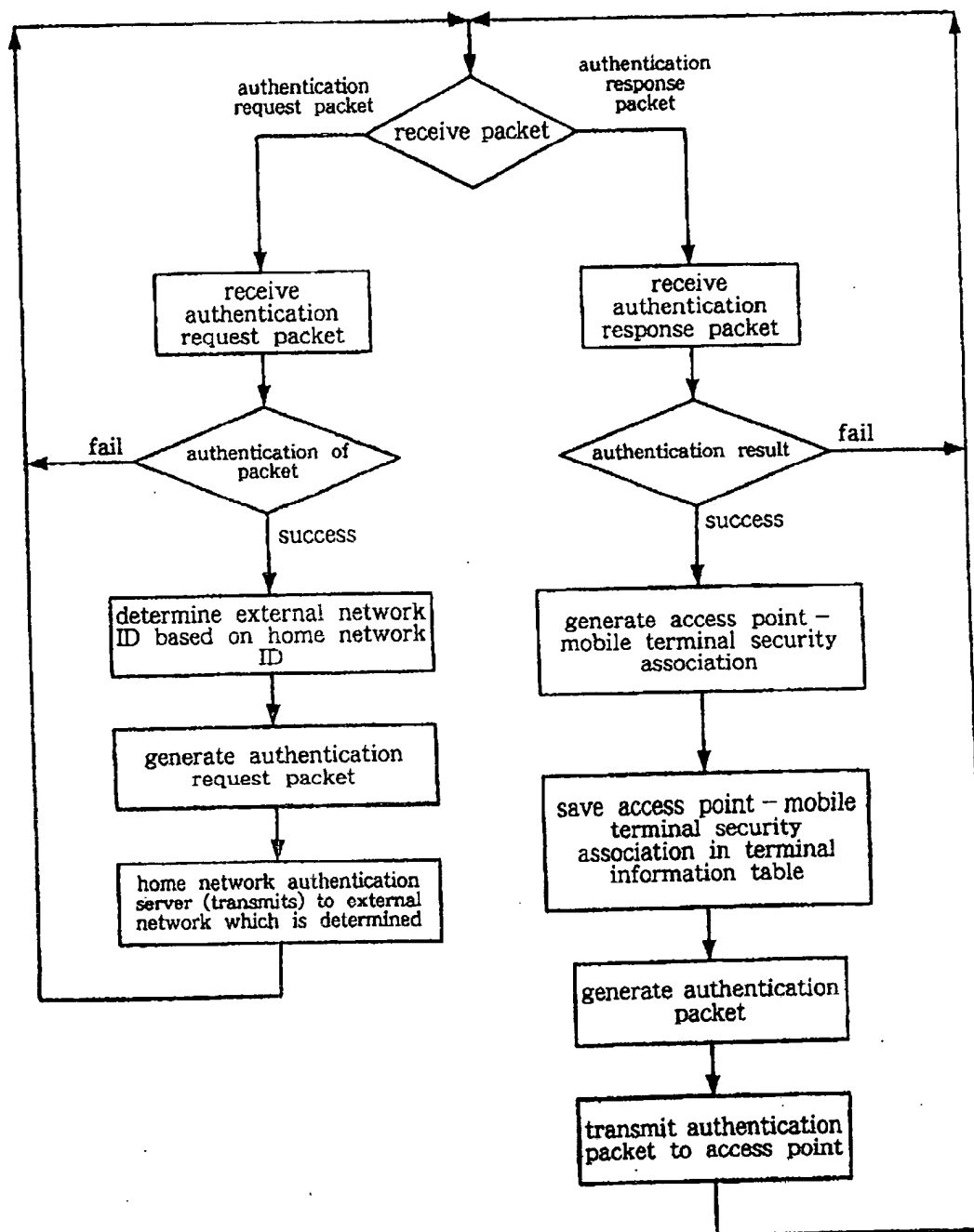


Fig.28

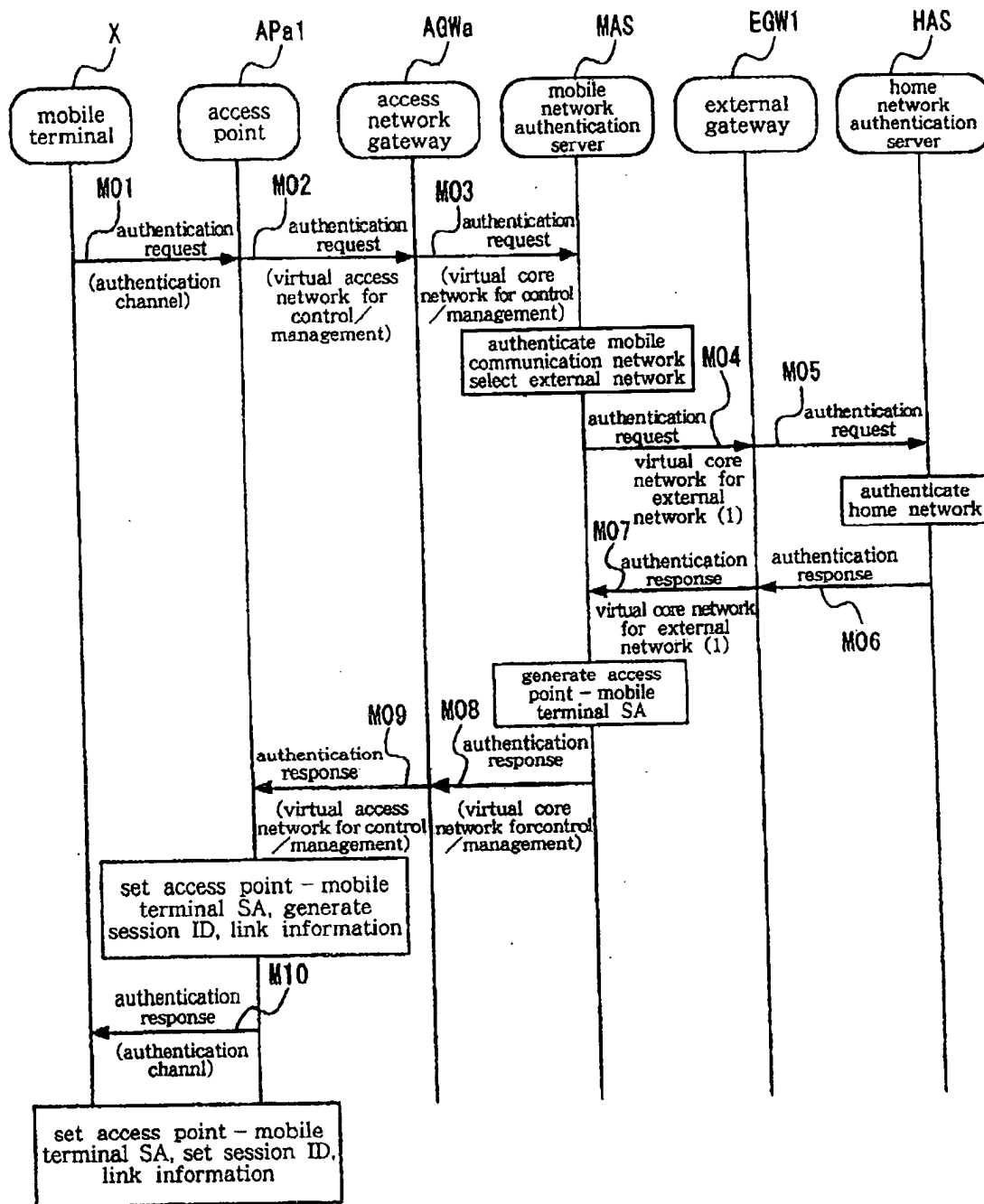


Fig.29

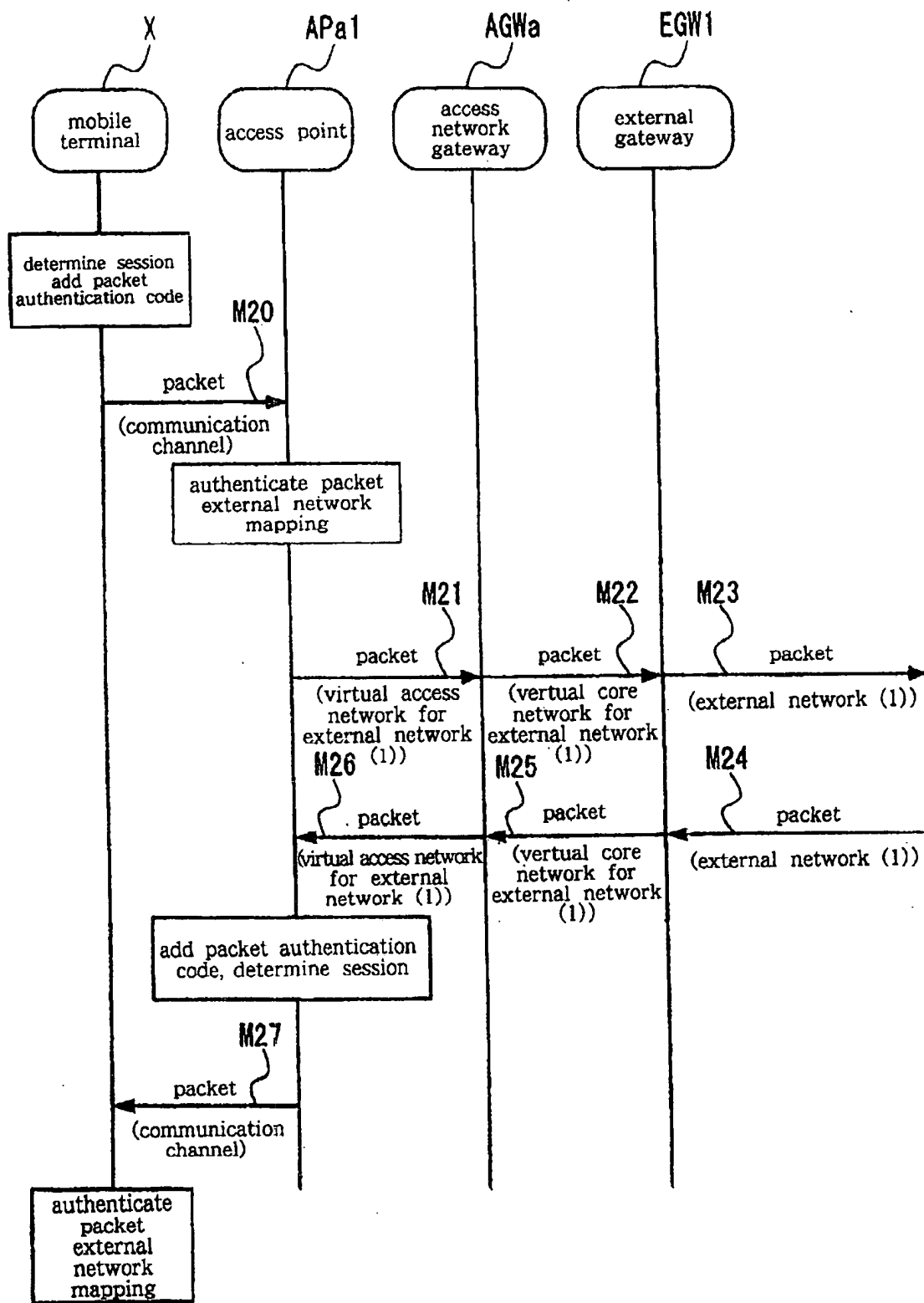


Fig.30

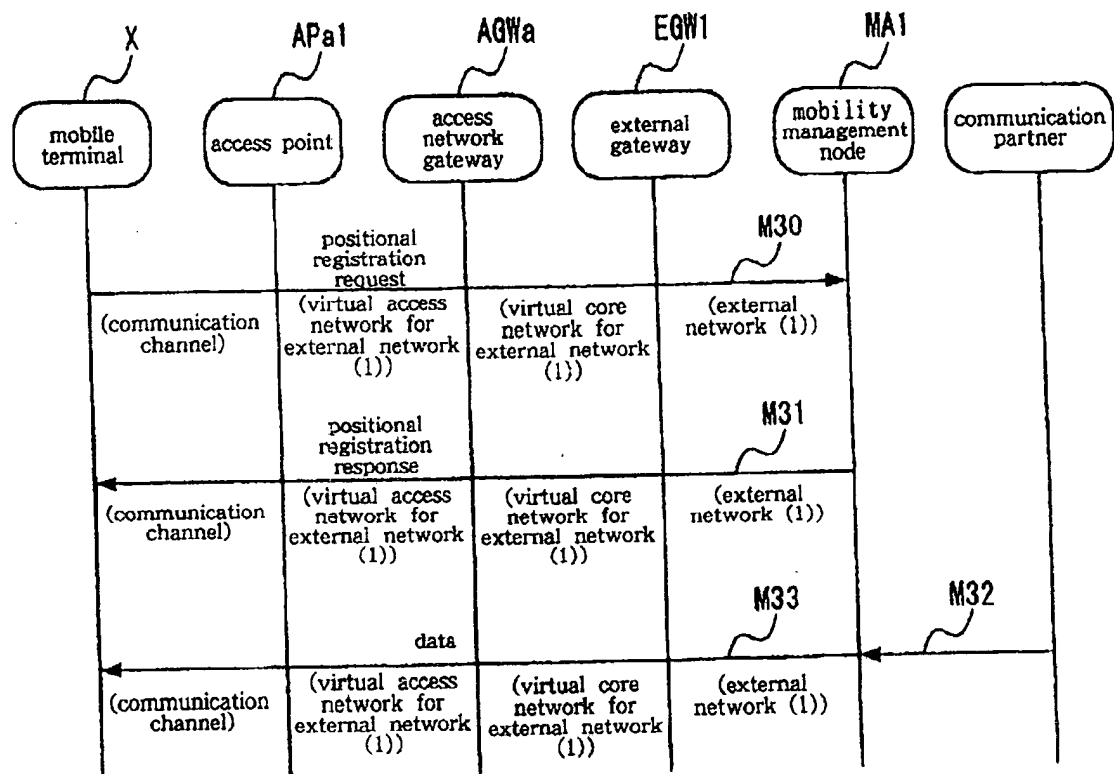


Fig.31

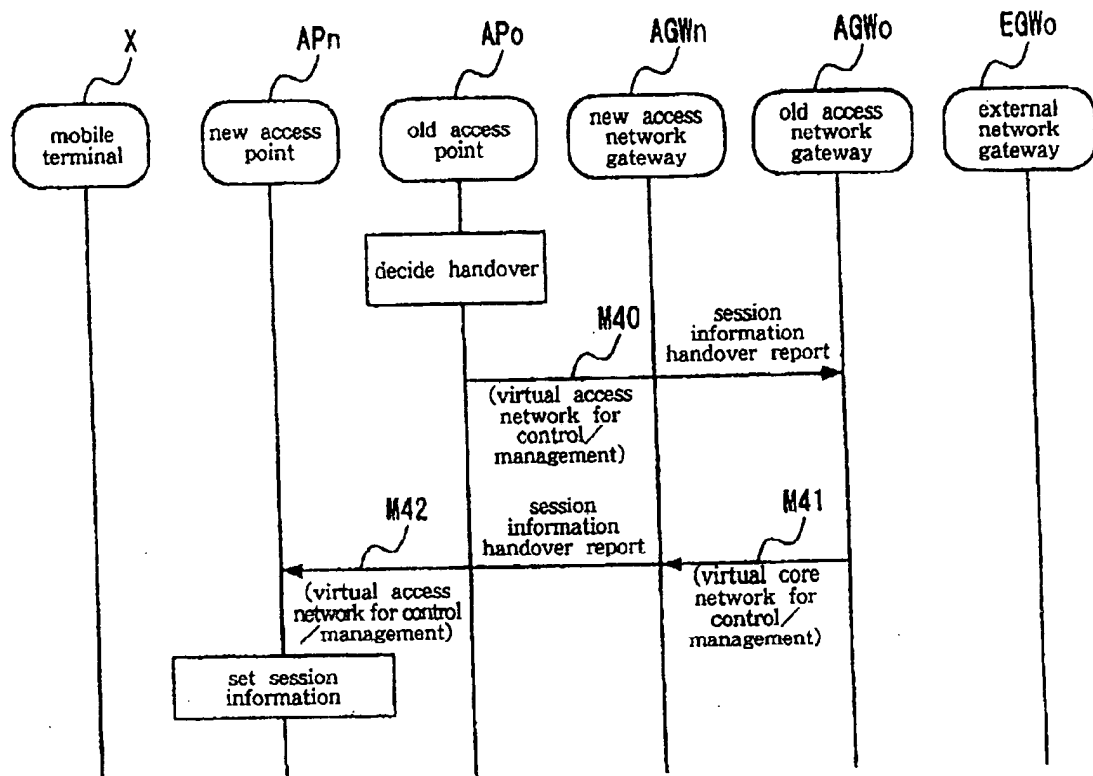


Fig.32

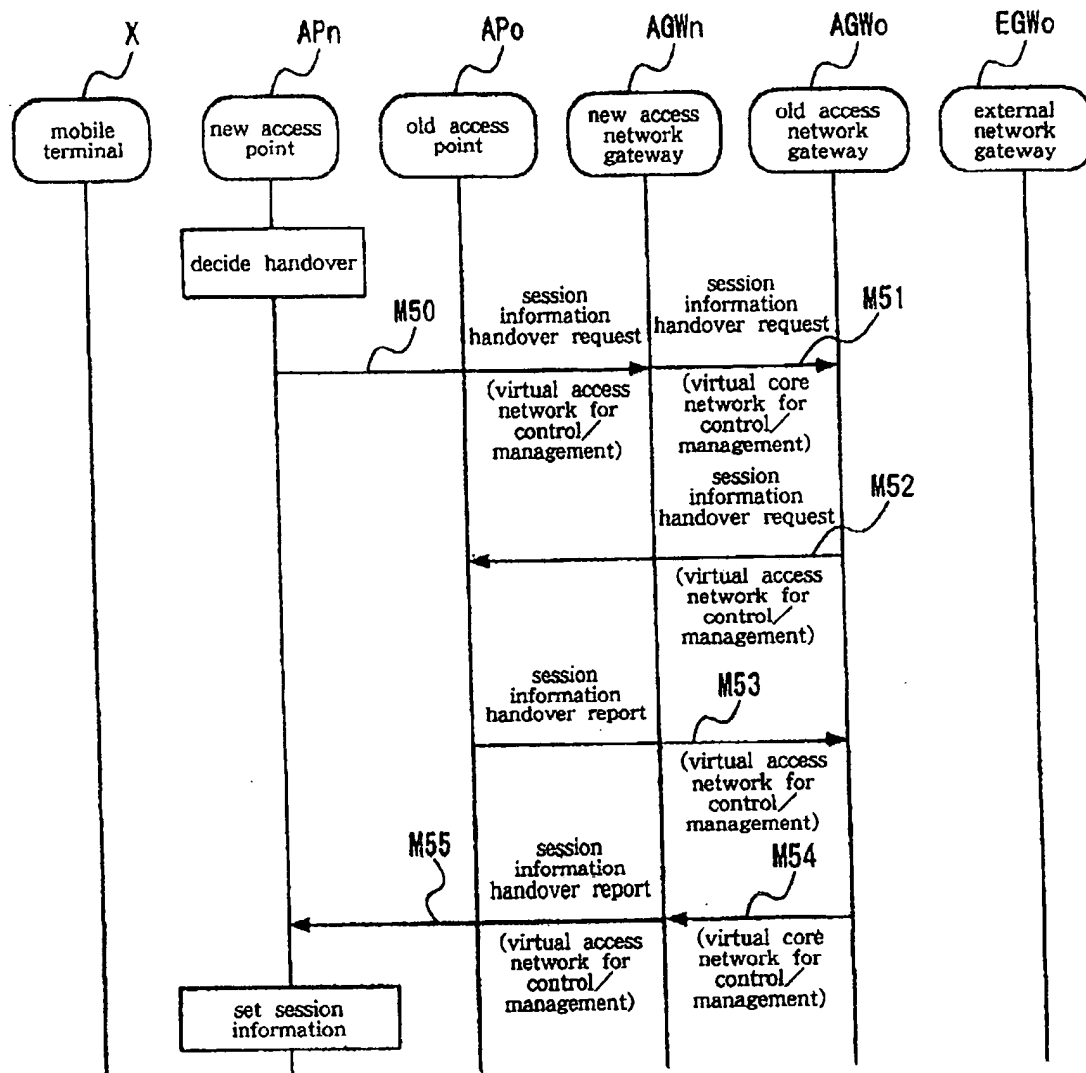


Fig.33

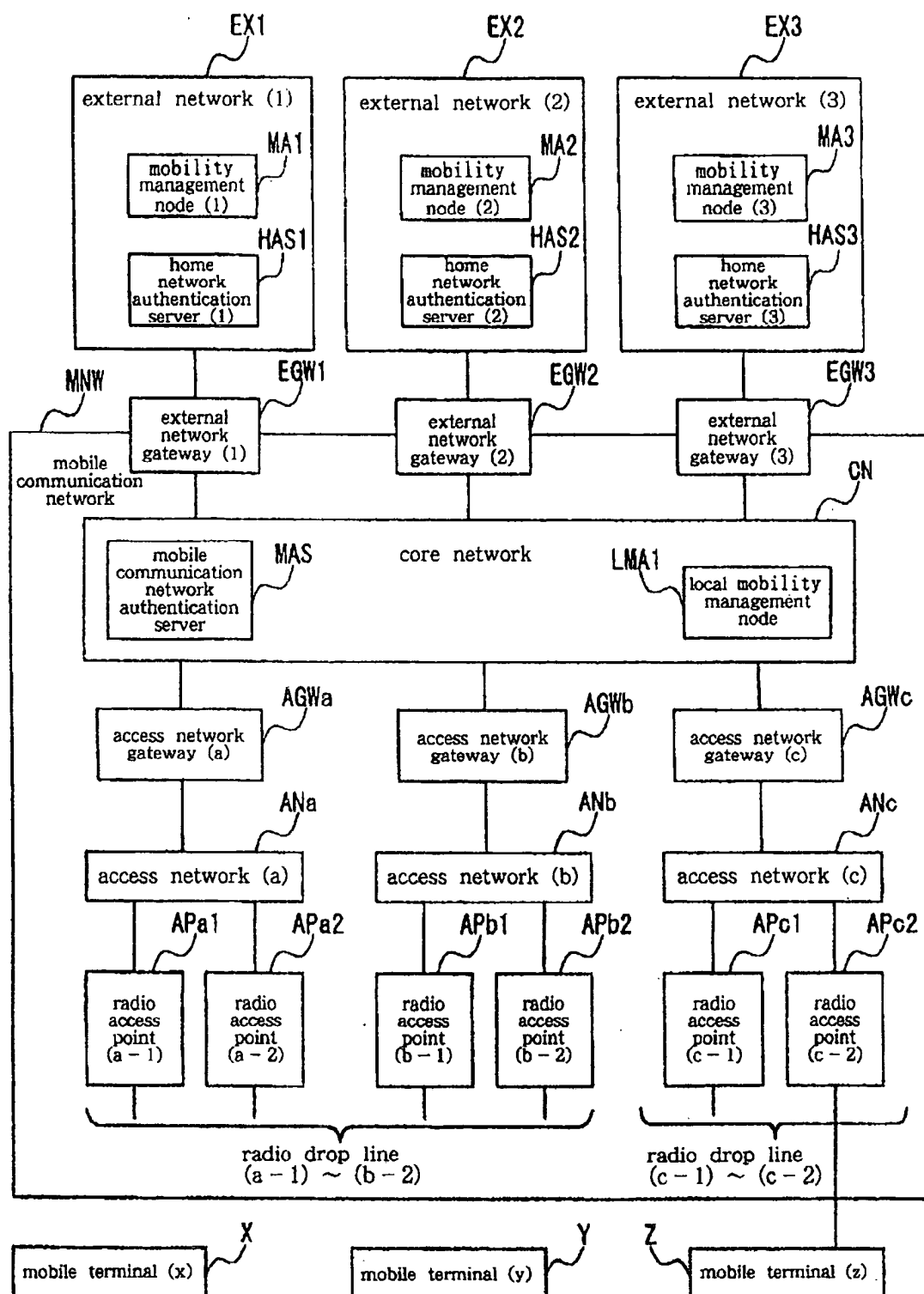


Fig. 34

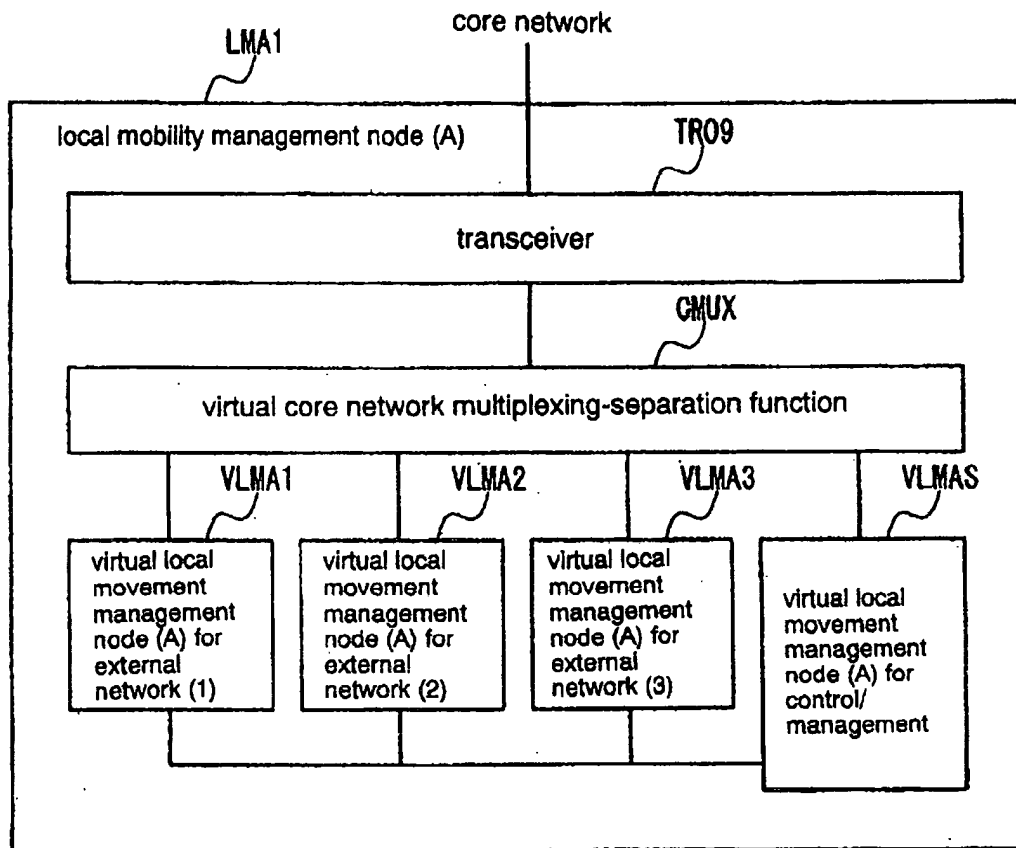
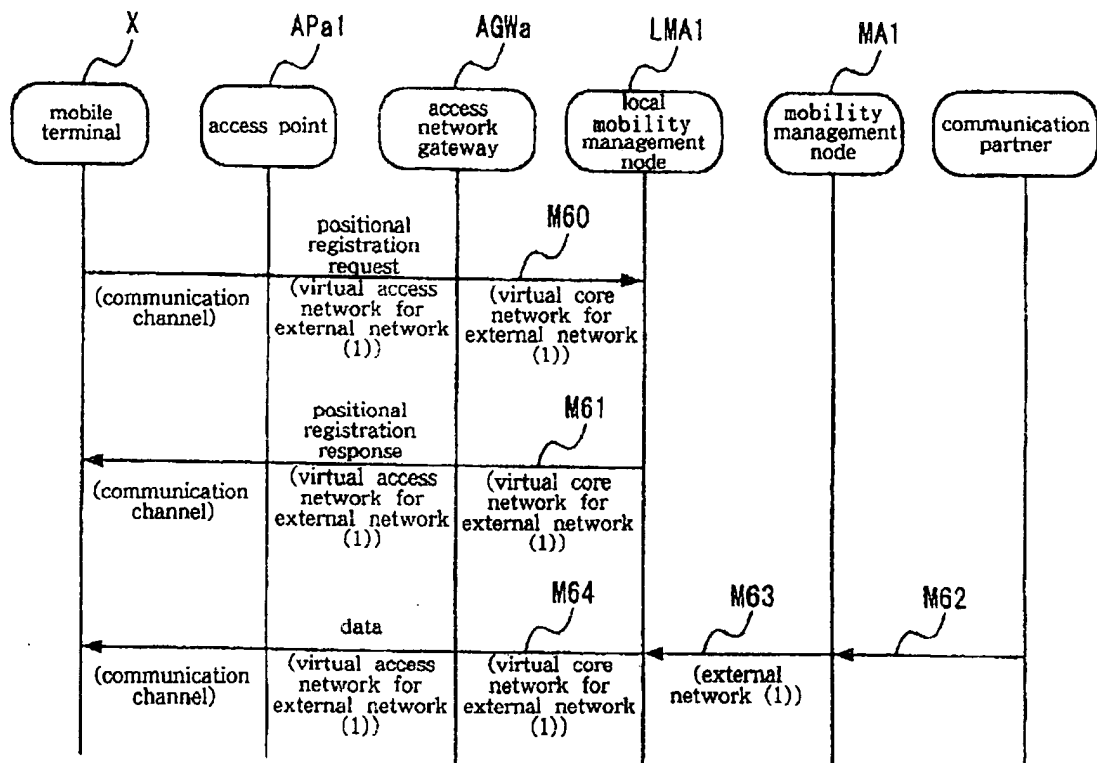


Fig.35



ABSTRACT

[Document Name] Abstract

[Abstract]

[Problems] A mobile communication method for realizing an improvement in the efficiency of circuit use when implementing communication between mobile terminals will be provided.

[Means to solve problems] A mobile terminal is provided with means for setting a session with an access point of a mobile communication network for the network that is wanted to connect. The mobile communication network is provided with means for multiplexing variety networks using virtual network technology. The access point is provided with means for connecting the session that has been set by the mobile terminal to the corresponding virtual network and means for transmitting the information of the session that has been set by the mobile terminal to a new access point from the current access point, when the mobile terminal moves to the jurisdiction of new access point.

[Selected Figure of the Drawings] Fig. 1